PROPOSED PLAN

Proposed Cleanup Alternative for the Kalispell Pole & Timber, Reliance Refinery, and Yale Oil Corporation State Superfund Facilities

Kalispell, Montana

Prepared by:

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Remediation Division
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INTRODUCTION

This Proposed Plan is an in-depth look at completing cleanup activities at the Kalispell Pole & Timber (KPT), Reliance Refinery Company (Reliance), and Yale Oil Corporation (Yale Oil) Facilities, which are Comprehensive Environmental Cleanup and Responsibility Act (CECRA – State Superfund) facilities in Flathead County, Montana. These facilities are collectively referred to as the "KRY Site" and will be referred to as such throughout the document whenever the complex as a whole is discussed. DEQ has determined there has been a release or substantial threat of a release into the environment that may present and imminent and substantial endangerment to the public health, safety or welfare or the environment. The Proposed Plan identifies and explains DEQ's preferred alternative for abating the imminent and substantial endangerment to public health, safety, and welfare and the environment from the release of pentachlorophenol (PCP), dioxins/furans, wood treating oil, and other hazardous or deleterious substances from the KRY Site. The document also summarizes the cleanup alternatives evaluated for the KRY Site. The Proposed Plan is issued by the Montana Department of Environmental Quality (DEQ), the lead agency for the KRY Site. DEQ will select the final remedial alternative for the KRY Site and present it in a Record of Decision (ROD) after reviewing and considering all the information submitted during the 30-day public comment period on the Proposed Plan. DEQ may modify the preferred alternative or select another alternative if it is demonstrated to be more appropriate or effective. The public is encouraged to comment and to offer suggestions for improving the alternative or reasons to implement other cleanup alternatives for the KRY Site. Concurrently with this Proposed Plan, DEQ is seeking public comment on the Final Draft Feasibility Study (FS), which as been posted on DEQ's website since July 2007, and an Addendum to the FS.

DEQ is issuing this Proposed Plan as part of its public participation responsibilities under Section 75-10-713, Montana Code Annotated (MCA). This Proposed Plan summarizes information found in greater detail in the Data Summary Report (DSR), Remedial Investigation/Feasibility Study (RI/FS), and other documents contained in the files for the KRY Site. The preferred alternative discussed in the Proposed Plan is based on the information found in these files. Information from these files is summarized in the following sections. The complete files are available to the public at DEQ's office in Helena, or you may view a partial compilation of these resources at the Flathead County Library in Kalispell or on DEQ's website at http://deq.mt.gov/StateSuperfund/kpt.asp.

Montana Department of Environmental Quality 1100 N. Last Chance Gulch Helena, MT 59601 406-841-5000	Business Hours:	Monday - Friday: 8:00 am – 5:00 pm
Flathead County Library 247 1st Ave. E. Kalispell, MT 59901 406-758-5820	Business Hours:	Monday – Thursday: 10:00 am – 8:00 pm Friday: 10:00 am – 5:00 pm Saturday: 11:00 am – 5:00 pm Sunday: Closed

PUBLIC INVOLVEMENT

Public involvement is an integral part of the Superfund process. DEQ encourages public comment on this Proposed Plan. The public comment period for the Final Draft FS, Addendum, and Proposed Plan will extend for thirty (30) days, from December 7, 2007 to 11:59 pm MST on January 5, 2008. Comments received through the postal service must be postmarked no later than January 5, 2008 and comments submitted electronically must be received no later than 11:59 pm MST on January 5, 2008. During this time, the public can comment in writing to:

Moriah Bucy
DEQ-Remediation Division
P.O. Box 200901
Helena, MT 59620-0901
or
mbucy@mt.gov

Additionally, a combined public meeting and hearing is scheduled to receive verbal comments. Verbal comments will not be accepted over the phone; however, you may call Moriah Bucy for additional information at 406-841-5064 or 1-800-246-8198.

DEQ will hold the combined public meeting and hearing on December 19, 2007 at 7:00 pm at the Cafeteria Gymnasium of the Evergreen School located at 18 West Evergreen Drive. DEQ will summarize the preferred alternative during the first segment of the public meeting and will answer questions concerning the preferred alternative. During the second portion of the meeting, questions will not be answered, but DEQ will accept and record verbal comments. A court reporter will be present to record those comments. A responsiveness summary, which is a written response to public comments, both written and verbal, will be included in the ROD.

BACKGROUND

The KRY Site is located on the northeastern edge but outside the city limits of the City of Kalispell in the community of Evergreen in Flathead County, Montana (Township 28 North, Range 21 West, Sections 5 and 8) (see Figure 1). The surficial boundaries of the KRY Site generally extend from the Stillwater River on the north and west, Highway 2 and the BNSF Railway Company (BNSF) railroad line on the east, Montclair Drive on the south, and Whitefish Stage Road on the west. The actual KRY Site boundaries are based on the extent of contamination, and groundwater contamination is known to extend to the southeast outside of these general boundaries and across Highway 2 (see Figure 2). The fenced area northeast of Reliance and adjacent to (east of) the railroad tracks is also part of the Reliance Facility. KPT is adjacent to Reliance and Yale Oil is to the southeast of the other two facilities. The three facilities are near the Stillwater River and residential areas.

Kalispell Pole & Timber Facility: The KPT Facility is a former wood treating facility, which operated from 1945 to 1990. Onsite soils and shallow (20-30 feet below ground surface (bgs)) groundwater are contaminated with PCP and associated dioxins/furans, polynuclear aromatic hydrocarbons (PAHs), and petroleum hydrocarbons. Shallow groundwater is also contaminated with metals. Deeper groundwater (100+ feet bgs) is contaminated with PCP. The facility is not fenced and currently a stone cutting operation and planer mill operates on a portion of the facility. The KPT Facility was listed on the Environmental Protection Agency's (EPA) Comprehensive Environmental Response, Compensation and Liability Act Information System (CERCLIS) list in August 1980. Notice of potential liability letters were sent to BNSF, Kalispell Pole & Timber Company, and Montana Mokko, Inc. in November 1995. Notice of potential liability letters were sent to Klingler Lumber Company (Klingler), Swank Enterprises (Swank) and the Montana Department of Natural Resources and Conservation (DNRC) in November 2001.

Reliance Refinery Company Facility: The Reliance Facility is a former oil refinery, which operated from 1924 to the 1960s. Soil is contaminated with petroleum hydrocarbons, PCP and associated dioxins/furans, and some metals, notably lead. The shallow groundwater under the facility is also contaminated with petroleum hydrocarbons, PCP, PAHs, dioxin/furans, and metals. The EPA Emergency Removal Program fenced the state-owned portion of the facility in 1988 in order to restrict access to sludge pits after reports of children playing in them. The facility is currently vacant. The Reliance Facility was listed on the CERCLIS list in January 1985. Notice of potential liability letters were sent to Klingler and Swank in November 1995, to BNSF in December 1995, and to DNRC and McElroy & Wilken, Inc. in November 2001. DEQ determined McElroy & Wilken was eligible for a subsurface migration exclusion in September 2002. DEQ retracted the notice letter to Klingler in October 2002 based on clarification of Klingler's status as an owner.

Yale Oil Corporation Facility: The Yale Oil Facility is a former petroleum bulk plant and product refinery which operated from 1938 to 1978. Thermal desorption was conducted on the soils to remove petroleum hydrocarbon contamination. However, shallow groundwater (20-30 feet bgs) under the facility is contaminated with PCP, dioxins/furans, and, although limited, petroleum hydrocarbons. Deeper groundwater (100+ feet bgs) is also contaminated with PCP. A commercial business currently exists on the facility. The Yale Oil Facility was listed on the CERCLIS list in January 1985. A notice of potential liability letter was sent to Exxon Corporation in August 1993.

PREVIOUS INVESTIGATIONS

There have been a number of investigations conducted at the KRY Site over the years. These investigations are briefly discussed below:

- The EPA and Montana Department of Health and Environmental Sciences (MDHES) (predecessor to DEQ) conducted site assessment activities, including a preliminary assessment, and Phase I, II, and III site investigations at the three facilities from 1985 to 1994. The investigations characterized contamination in soil, sludge, and groundwater and gathered historical data for Comprehensive Environmental Response, Compensation and Liability Act (CERCLA – a.k.a. federal Superfund) purposes. A draft hazard ranking system (HRS) package was developed for the KPT and Reliance facilities. The draft HRS package indicated that the KPT and Reliance Facilities were candidates for the federal National Priorities List (NPL).

- In 1989, Exxon consultants prepared a remediation plan and conducted a test burn to determine the safety and effectiveness of using thermal desorption on contaminated soils at the Yale Oil Facility.

- In 1991, EPA consultants conducted a detailed hydrogeologic investigation at the three facilities to better define groundwater movement and contamination in soil and groundwater. This investigation was the result of an MDHES request for EPA emergency removal action in 1990.

- In 1994, BNSF Railway Company (BNSF) consultants completed an investigation at the KPT Facility to confirm the results of previous investigations, replace damaged monitoring wells, and collect additional data. Free-product or a petroleum sheen was detected in most of the monitoring wells during most sampling events. The free-product was generally less than one foot thick. A plume of dissolved PCP and dioxins/furans was also found.

- In 1994 and 1995, Exxon consultants conducted quarterly groundwater monitoring of the Yale Oil Facility wells. Samples were analyzed for gasoline and diesel-range organic compounds, phenols, and semi-volatile organic compounds (SVOCs). Phenols were detected in samples from monitoring wells at Yale Oil.

- In 1996, BNSF consultants began additional investigations to delineate the contaminant plumes of PCP and free-product at the KPT Facility. BNSF consultants installed five new monitoring wells.

- In 1996, DEQ sampled local domestic wells and found PCP and petroleum contamination for the first time since a 1991 sampling event.

- In 1996, DEQ consultants completed a draft RI for a portion of the Reliance Facility. A Final Draft FS Report was prepared in December 1997. The RI was finalized as a Phase I RI report in December 2000.

- In 1997 and 1998, BNSF consultants conducted a supplemental RI for the KPT Facility. The purpose of this investigation was to fill data gaps identified during the investigation in 1994; delineate the downgradient extent of the plume of dissolved PCP; characterize the western edge of light non-aqueous phase liquid (free-product) contamination; calculate the direction of groundwater flow in the northern portion of the facility; calculate groundwater velocity during low-water periods; and assess the extent of surface PCP contamination in soil.

- In November 2000 and May 2002, Exxon consultants conducted groundwater monitoring of wells at the Yale Oil Facility. Samples were analyzed for extractable petroleum hydrocarbons (EPH) and volatile petroleum hydrocarbons (VPH) constituents. Some EPH and VPH constituents were detected above screening levels.

- In 2001, BNSF consultants resumed sampling of groundwater monitoring wells at the KPT Facility to further define the magnitude and extent of contamination associated with the KPT

Facility. Samples were analyzed for PCP, EPH, SVOCs, and dioxins/furans. BNSF consultants have conducted semi-annual groundwater sampling on select wells since 2001.

- In 2002, DNRC consultants conducted an interim investigation at the Reliance Facility to address specific data gaps and to initiate groundwater remediation. Two free-product recovery wells were installed, and recovery of free-product began in July 2002. Additional soil samples were collected to further characterize contamination in soil across the facility. Two groundwater monitoring events were conducted in conjunction with monitoring for the adjacent KPT Facility. DNRC submitted a Phase II RI/FS to DEQ in December 2002.

- In November 2005, BNSF consultants conducted monitoring well installation, soil borings, and surface soil sampling at the KPT and Reliance facilities.

- In November 2005, Western Research Institute (WRI), in cooperation with DEQ, conducted groundwater and soil sampling to evaluate natural attenuation and biodegradation at the KRY Site.

- In April 2006 through August 2006, DEQ consultants conducted RI field work to collect data for a comprehensive RI report for the KRY Site. A Final Draft RI report was prepared in January 2007 and public comment was received and analyzed. DEQ is issuing the Responsiveness Summary on the Final Draft RI concurrently with this Proposed Plan. Changes in the RI necessitated by public comment will be made and the RI will be finalized prior to issuance of the ROD.

- In August 2006, DEQ began recording monthly groundwater and free-product thickness measurements from monitoring wells associated with the KRY Site. This effort continued through July 2007.

- In October 2006, DEQ sampled five nearby residential wells to follow-up on PCP detections observed from the RI sampling event. Samples were collected from the five wells on a quarterly basis for one year. PCP was not detected in any of the samples collected from these residential wells. DEQ intends to require sampling to ensure that PCP levels in these wells do not exceed drinking water standards.

- In October 2007, DEQ consultants collected surface water and sediment samples from the Stillwater River to aid in determining whether cleanup of the potential dioxin/furan contamination in the river is warranted.

<u>INTERIM REMEDIAL ACTIONS</u>

- In 1993, Exxon conducted a voluntary cleanup action at the Yale Oil Facility that consisted of removing a tank bottom and the sludge within the tank bottom plus the contaminated soils associated with the tank bottom. Piping and stained soils associated with the piping were also excavated and thermally desorbed; 10,465 tons of contaminated soil were treated through the thermal desorption unit and subsequently used as backfill material.

- In 1996, BNSF consultants began a pilot scale air-sparging program to evaluate the effectiveness of the technology on reducing concentrations of dissolved PCP.

- In 1997, BNSF connected one local residence to the city water system.

- In April 1999, BNSF excavated soil as an interim action to remove PCP hot spots in shallow soils at the KPT Facility and transport them off-site for disposal at an appropriate facility. This action occurred before the regulations were promulgated that prohibited this type of soil and debris from land disposal. BNSF consultants excavated approximately 470 cubic yards of contaminated soils from the former treatment area located at the KPT Facility.

- In 1999, BNSF contractors expanded the air-sparging system and converted it to a pilot-scale ozonation system to partially remediate contaminated groundwater at the BNSF-owned portion of the KPT Facility. This action was conditionally-approved by DEQ.

- In July 2002, DNRC consultants installed two 12-inch diameter wells on the Reliance Facility. In August 2002, belt skimmers were installed in the wells to recover free-product from the groundwater.

- In 2004, BNSF upgraded the ozonation system to be a full-scale system without DEQ approval or oversight.

- In September 2006, BNSF again modified the ozonation system without DEQ approval or oversight.

SITE CHARACTERISTICS

Geology

The KPT, Reliance, and Yale Oil facilities are located adjacent to or in proximity to the Stillwater River, just north of Kalispell. The area in the vicinity of the KRY Site is a relatively flat, broad floodplain that is composed of clay- to cobble-sized materials.

Groundwater

Groundwater is present in an unconfined aquifer of sands, silts, and gravels. In general, groundwater is encountered at approximately 20 feet below ground surface and may be from 80 to 125 feet deep in certain areas of the Site. Below the unconfined groundwater unit is a dense confining unit consisting of clays and gravely silts. The confining unit was encountered from a depth of 80 feet down to 243 feet below ground surface at various locations throughout the KRY Site. The maximum depth and thickness of the confining unit was not estimated during the RI. However, this confining unit appears to limit the deeper migration of contamination in the groundwater.

Groundwater level measurements indicate that groundwater flow is generally from west to east in both the shallow and deeper portions of the unconfined aquifer (Figure 4). However, there are two areas in the shallow portion of the unconfined aquifer that show steeper gradients and varying directions of groundwater flow. Groundwater in these areas moves radially away from these locations and eventually returns to the shallow groundwater flow system which generally flows from west to east. Hydraulic conductivities of 17 to 326 feet per day (ft/day) were calculated from the results of an aquifer pumping test conducted in August 2006 as part of the RI (Table 1).

Domestic water supply wells that could supply drinking water are located adjacent to and within the KRY Site in the shallow groundwater (Figure 3). In addition, other domestic (such as irrigation), commercial, and non-domestic use water is known to come from the shallow aquifer via several individual wells.

The groundwater and surface water in the area are generally interconnected, with the Stillwater River discharging to the upper aquifer near the KRY Site. Based on monthly water level measurements collected by DEQ, it appears that at times of high water (approximately May) the influx of water causes the groundwater flow to change direction so that it is flowing in a more northeasterly direction**.** This change in flow direction does not appear to last long, and eventually the groundwater flow returns to its general west to east direction.

Surface Water

The KPT, Reliance, and Yale Oil facilities are located south and west of the Stillwater River (Figure 1-1). The river generally flows from west to east, but there are currently no nearby operational stream gauging stations. It appears that the majority of the KRY Site is situated outside of the 100- and 500-year floodplains, except for a small area on the west side of the KPT Facility and a small area near the railroad tracks on the northeastern edge of the Reliance Facility. The Board of Environmental Review (BER) classifies the Whitefish River from the outlet of Whitefish Lake to the Stillwater River as B-2 and the Flathead River above Flathead Lake as B-1 (Administrative Rules of Montana 17.30.608). These classifications indicate that waters should be suitable for drinking, culinary use, and food processing after conventional treatment; for bathing, swimming, and recreation; for growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl, and furbearers; and for agricultural and industrial water supply.

Surface water levels near the KRY Site were compared with groundwater levels in adjacent monitoring wells (**Figure 3).** The surface water elevation was higher than the adjacent groundwater elevation at all three locations, indicating that the river was recharging the shallow aquifer at these locations during the periods of measurement. Regions of groundwater to surface water recharge are likely present upgradient or downgradient (or both) of the KRY Site.

Site Contamination

DEQ used appropriate existing data and conducted additional sampling during the RI to (1) identify sources of contamination, (2) determine the extent of contamination in soils, groundwater, surface water, and sediment, (3) collect data necessary to determine risks to human health and the environment; and (4) collect site-specific data necessary to develop and evaluate cleanup options. During the RI groundwater, surface soil, subsurface soil, surface water, and sediment were sampled. Sludge in soil and free-product on groundwater were also included as part of the investigation.

The findings of the RI are summarized below:

<u>Groundwater</u>

Groundwater at the KRY Site is contaminated with SVOCs including PCP and PAHs, dioxins/furans, volatile organic compounds (VOCs), petroleum hydrocarbons, and metals (Figure 5).

During the 2006 RI, groundwater was sampled from some monitoring wells, residential wells, industrial wells, and public water supply wells at the KRY Site and nearby areas.
Low-levels of PCP were found in nearby residential wells; however, none of the levels exceeded EPA's drinking water standards or the Montana numeric water quality (DEQ-7) standards. No contaminants were found in industrial or public supply wells at levels that exceed EPA drinking water standards or DEQ-7 standards.

Data from the monitoring wells sampled indicates that the groundwater within and downgradient of the KRY Site is contaminated with chemicals at levels greater than both federal and state regulatory standards. The highest levels of PCP (detected at a maximum concentration of 16,300 micrograms per liter (ug/L)), dioxins/furans (maximum concentration of 1,346 picograms per liter (pg/L)), and SVOCs (for instance naphthalene, detected at a maximum concentration of 178 ug/L) in groundwater at the KRY Site were found within and downgradient of the KPT Facility. Lower-levels of PCP, dioxins/furans, and SVOCs were found within the Reliance Facility and downgradient of the Reliance Facility at the Yale Oil Facility. The extent of the contamination in the shallow (20-30 feet bgs) groundwater has generally been determined. However, the eastern edge of groundwater contamination is not well defined in the deeper (100+ feet bgs) groundwater near the Town Pump on Highway 2 East. The highest levels of petroleum contamination (for instance C5-C8 aliphatics, detected at a maximum concentration of 8,550 ug/L) at the KRY Site were found within the KPT and Reliance Facilities. Lower levels are found within and around the Yale Oil Facility. Additional information regarding minimum and maximum concentrations for individual chemicals detected in groundwater can be found on Table 4-1 of the Final Draft RI.

A large area of free-product overlies the groundwater at both the KPT and Reliance facilities and free-product thicknesses are generally less than one foot. The free-product at the KPT Facility is light brown in color with a strong chemical odor. The free-product at the Reliance Facility is dark-brown to black in color, extremely viscous (almost tar-like) and has a strong petroleum odor.

<u>Soil</u>

Surface (0-2 feet bgs) and subsurface (greater than 2 feet bgs) soil samples were collected throughout the KRY Site and at nearby businesses and homes. Surface and subsurface soils at the KRY Site are contaminated with SVOCs (for instance naphthalene, detected at a maximum concentration of 260 milligrams per kilogram (mg/kg)) including PCP (maximum concentration of 6,900 mg/kg) and PAHs (for instance benzo(b)fluoranthene, detected at a maximum concentration of 5.47 mg/kg), dioxins/furans (maximum concentration of 171,510 ng/kg), VOCs (for instance ethylbenzene, detected at a maximum concentration of 83 mg/kg), petroleum hydrocarbons (for instance C19-C36 aliphatics, detected at a maximum concentration of 402,000 mg/kg), and metals, most notably lead (maximum concentration of 44,300 mg/kg) (Figures 6 and 7). Additional information regarding concentrations for individual chemicals detected in soil can be found on Tables 4-2 and 4-3 of the Final Draft RI.

Petroleum sludge is also present at the Reliance Facility (Figure 8). One isolated surface sludge pit (approximately 40 feet long by 12 feet wide) is located within the fenced portion of Reliance near the northeast corner between BNSF's mainline and spur line railroad grades. In addition to the main sludge pit, several minor, very shallow surface expressions of sludge occur along the east fence line. However, these deposits are not extensive in area or volume. Additionally, a few isolated areas of thin subsurface sludge layers were encountered in test pits along the eastern edge of the Reliance Facility. However, these deposits were sporadic and volumes were minimal. The sludge is not classified as a Resource Conservation and Recovery Act (RCRA) hazardous waste based on sample results.

An isolated area of buried sawdust exists in the vicinity of monitoring well KRY-103A at the KPT Facility. The sawdust extends to a depth of approximately 14 feet in this area.

Stillwater River

During the RI, limited surface water and sediment samples were collected from the Stillwater River, which is adjacent to the KPT and Reliance facilities. Metals (for instance aluminum at 250 ug/L) and dioxins/furans (2.17 pg/L) were detected in surface water samples. Metals (for instance aluminum at 11,300 mg/kg), dioxins/furans (0.5931 ng/kg), SVOCs (for instance fluoranthene, 0.26 mg/kg), and petroleum compounds (for instance C1-C22 aromatics at 15 mg/kg) were detected in surface water. Dioxins/furans were detected at levels above screening criteria in surface water, but there were no chemicals detected in sediment samples at levels above sediment screening criteria. Additional information regarding concentrations for individual chemicals detected in surface water and sediment can be found on Tables 4-4 and 4-5 of the Final Draft RI.

The presence of dioxins/furans in surface water showed potential impacts to the nearby Stillwater River. Dioxins/furans generally adhere strongly to soils and would be expected to be found in sediments at levels that correspond to those detected in surface water, but were not. Because the sediment concentrations were inconsistent with the surface water concentrations and because a limited number of surface water/sediment samples (three, plus a duplicate) were analyzed for dioxins/furans, DEQ contractors conducted additional sampling of the Stillwater River surface water in October 2007. As reported in the Addendum to the FS, this sampling demonstrated that there was no significant difference between dioxin/furan concentrations in the surface water at sample locations throughout the reach of the Stillwater River adjacent to the KRY Site, regardless of flow conditions. Therefore, DEQ has not identified contaminants of concern (COCs) for surface water or sediments at the KRY Site and no additional investigation or cleanup of the river is proposed in this plan.

SUMMARY OF HUMAN HEALTH AND ECOLOGICAL RISK ANALYSIS

DEQ compared the COC concentrations at the KRY Site with generic screening levels and approved site-specific cleanup levels from other CECRA facilities. Based upon this evaluation, DEQ determined that the COC concentrations at the KRY Site represent unacceptable risks. Therefore, DEQ did not quantify those risks but rather developed site-specific cleanup levels for the COCs at the KRY Site. The fact that COCs exceed these cleanup levels further supports the determination that unacceptable risks exist and that remediation is necessary.

DEQ developed risk-based cleanup levels generally using the approach employed for the Missoula White Pine & Sash (MWPS) Facility in Missoula, Montana, including a qualitative evaluation of ecological risks. DEQ chose this approach because of the similarities between the KRY Site and the MWPS Facility. In general, both the KRY Site and the MWPS Facility have similar types of contamination, geology/hydrogeology, demographics, climate, and ecology. A site-specific fate and transport evaluation was also conducted using data gathered during the RI. The complete risk analysis memo and fate and transport evaluation are provided in Appendix C of the Final Draft FS.

Human Health Risks

Current and future land and groundwater use were evaluated as part of the risk analysis. The properties that make up the KRY Site are zoned for commercial/industrial use (with the exception of the residential area, which is likely to remain residential) and have always been used for commercial/industrial purposes. Development in the general area is for commercial/industrial use, and due to the availability of residential building sites in other areas of the Flathead Valley, there is unlikely to be additional residential development in the vicinity of the KRY Site. DEQ contacted the owners of the properties that make up the KRY Site to request information about anticipated land use and received word that the properties were expected to remain as commercial/industrial use. Through this assessment, DEQ has determined that the reasonably anticipated future use of the property is commercial/industrial and anticipates requiring restrictive covenants limiting the future use of the property to commercial/industrial as part of the remedy. Additionally, it is anticipated that a controlled groundwater area will be proposed for the KRY Site that would prohibit the installation of drinking water wells until such time as the groundwater meets water quality standards.

Populations that could be exposed to contamination at the KRY Site include current and future residents, current and future commercial/industrial workers, current and future trespassers, future construction workers, current and future Stillwater River recreators, and current and future ecological receptors.

These populations have the potential to come in contact with contaminants through dermal contact with contaminated soil, groundwater, and surface water; ingestion of soil, groundwater, surface water, produce grown in contaminated soil, and breast milk; and inhalation of contaminated dust, volatiles released during use of groundwater, and volatiles released from groundwater into indoor air.

DEQ has conducted an evaluation of receptors and pathways and determined that some of the previously mentioned pathways are not complete or do not need to be quantitatively evaluated. These pathways are: 1) exposure to soil by future residents; 2) exposure of current residents via the vapor intrusion pathway; 3) inhalation of volatiles during use of groundwater by current and future commercial/industrial workers; 4) current and future trespassers; 5) current and future Stillwater River recreators; and 6) current and future ecological receptors. Additional details regarding the justification for elimination of the above pathways can be found in Appendix C of the Final Draft FS.

Determination of COCs and Cleanup Levels

DEQ determined which COCs should be retained from the list of contaminants of potential concern (COPCs) presented in the Final Draft RI Report. The primary COCs for the KRY Site are PCP, dioxins/furans, and petroleum compounds, although there are other COCs for which site-specific cleanup numbers were calculated. Health effects of these primary contaminants are discussed below:

- PCP: According to the Agency for Toxic Substances and Disease Registry (ATSDR), PCP is a manmade chemical that does not occur naturally. It was widely used as a pesticide and wood preservative but the purchase and use of PCP has been restricted to certified applicators since 1984. Therefore, it is no longer available to the general public although it is still used industrially. PCP can be found in the air, water, and soil. Studies in workers show that exposure to high levels of PCP can cause the cells in the body to produce excess heat. When this occurs, a person may experience a very high fever, profuse sweating, and difficulty breathing. The body temperature can increase to dangerous levels, causing injury to various organs and tissues, and even death. Liver effects and damage to the immune system have also been observed in humans exposed to high levels of PCP for a long time. The EPA has determined that PCP is a probable human carcinogen and the International Agency for Cancer Research (IARC) considers it possibly carcinogenic to humans.

- Dioxins/furans: According to ATSDR, dioxins are a family of 75 chemically related compounds commonly known as chlorinated dioxins. These compounds are referred to as congeners and one congener, 2,3,7,8-TCDD, is the most toxic and therefore, is the most studied. Dioxins may exist naturally due to the incomplete combustion of organic material by forest fires or volcanic activity. Dioxins are not intentionally manufactured by industry, except in small amounts for research purposes; however, industrial, municipal, and domestic incineration and combustion processes can produce dioxins. The most noted health effect in people exposed to large amounts of 2,3,7,8-TCDD is chloracne. Chloracne is a severe skin disease with acne-like lesions that occur mainly on the face and upper body. Other skin effects noted in people exposed to high doses of 2,3,7,8-TCDD include skin rashes, discoloration, and excessive body hair. Liver damage and changes to metabolism and hormone levels are also seen in people. In certain animal species, 2,3,7,8-TCDD is especially harmful and can cause death after a single exposure. Exposure to lower levels can cause a variety of effects in animals, such as weight loss, liver damage, and disruption of the endocrine system, weakening of the immune system, reproductive damage and birth defects. EPA considers dioxins and furans to be probable human carcinogens, while the World Health Organization (WHO) considers them to be known human carcinogens.

- Petroleum hydrocarbons: Health effects from exposure to petroleum hydrocarbons depend on many factors, including the type of chemical compounds in the petroleum hydrocarbons, how long the exposure lasts, and the amount of the chemicals contacted. Very little is known about the toxicity of many petroleum hydrocarbon compounds. Until more information is available, information about health effects of petroleum hydrocarbons must be based on specific compounds or on data for petroleum products that have been studied. According to ATSDR, the compounds in some petroleum hydrocarbon fractions can affect the blood, immune system, liver, spleen, kidneys, developing fetus, and lungs. Certain petroleum hydrocarbon compounds can be irritating to the skin and eyes and can cause neurological affects consisting primarily of central nervous system depression. Other petroleum hydrocarbon compounds, such as some mineral oils, are not very toxic and are used in foods.

- Lead: According to ATSDR, human exposure to lead occurs primarily through diet, air, drinking water, dust, and paint chips. The efficiency of lead absorption depends on the route of exposure, age, and nutritional status. Adult humans generally ingest less lead than children. Lead exposure in humans affects almost every organ and system in the human body. The most sensitive system is the central nervous system, particularly in children. Irreversible brain damage occurs at blood lead levels greater than or equal to 100 micrograms per deciliter (µg/dL) in adults and at 80 to 100 µg/dL in children; death can occur at the same blood levels in children. Children who survive these high levels of exposure may suffer permanent, severe mental retardation. Lead also damages kidneys and the reproductive system. The effects are the same whether it is breathed or swallowed. At high levels, lead may decrease reaction time, cause weakness in fingers, wrists, or ankles, and possibly affect the memory. Lead may also cause anemia, a disorder of the blood. EPA has evaluated inorganic lead and lead compounds for carcinogenicity. The data from human studies are inadequate for evaluating the potential carcinogenicity of lead. Data from animal studies, however, are sufficient based on numerous studies showing that lead causes tumors in animals.

The following sections provide a discussion of COCs for each media, a discussion of the calculation of cleanup levels, and the established cleanup levels. These cleanup levels will reduce the public health risk associated with exposure to soil contaminants to an acceptable level, and minimize migration of contaminants into the groundwater.

Groundwater

For compounds that have them, the Montana numeric water quality standards (DEQ-7 standards) are the applicable cleanup level. To simplify dioxin/furan analysis, a toxicity equivalence (TEQ) using World Health Organization 1998 (WHO 1998) toxicity equivalence factors (TEFs) is calculated for each sample. Because dioxin/furan concentrations are a sum total of many different chemical compounds, this TEQ concentration is calculated by adjusting the concentrations of several of the dioxin/furan compounds to account for their toxicity and then adding all of the adjusted concentrations. For dioxins/furans and metals, DEQ took into account concentrations from the newly installed background monitoring well and when the background concentration exceeds the DEQ-7 standard, the background concentration will be used as the cleanup level. These particular compounds are found naturally in the environment and DEQ accounted for that using the background concentrations. DEQ will also apply Risk-Based Corrective Action (RBCA) risk-based screening levels (RBSLs) for petroleum compounds and EPA Region IX tap water preliminary remediation goals (PRGs) for compounds that do not have DEQ-7 standards or RBSLs. For compounds without DEQ-7 standards, DEQ has chosen to utilize existing screening levels as cleanup levels, rather than calculating site-specific cleanup levels because the assumptions used to calculate both types of levels are the same and therefore the levels themselves would be the same. The COCs for groundwater, along with their corresponding cleanup levels, are provided in Table 2.

Soils

Direct contact cleanup levels were calculated for soils using equations developed by the EPA. Compounds were separated based on their effect (i.e., non-carcinogenic or carcinogenic). Hazard quotients were calculated for non-carcinogenic compounds in each media (surface and subsurface soil) based on target organs or critical effects to ensure that the total hazard index does not exceed 1 for any organ or effect. Cancer risks were calculated for carcinogenic compounds in each media (surface and subsurface soil) to ensure that the total cancer risk does not exceed a one in 100,000 individual excess lifetime cancer risk ($1x10^{-5}$). The most recent toxicity information available was used to calculate cleanup levels.

DEQ has developed site-specific target levels for the soil leaching to groundwater pathway at the KRY Site. These site-specific target levels are concentrations of COCs in surface and subsurface soils that are protective of groundwater (DEQ-7 standards or other cleanup levels for groundwater listed on Table 2).

The COCs for each media (surface soil and subsurface soil) for dermal contact and leaching to groundwater are provided in Tables 3 and 4, along with their corresponding cleanup levels. To simplify dioxin/furan analysis, a TEQ using WHO 2005 TEFs is calculated for each sample and compared to a TEQ cleanup level. DEQ has also calculated one cleanup level for the carcinogenic polycyclic aromatic hydrocarbons (cPAHs). DEQ will apply EPA TEFs relative to benzo(a)pyrene (the most toxic of the PAH compounds) to concentrations of cPAHs for comparison to the cleanup level. Cleanup levels for PAHS that are non-carcinogenic are included with the other noncarcinogenic compounds. To ensure protection of public health, safety, and welfare and the environment, the most conservative of the leaching to groundwater or direct contact cleanup levels will be used as the cleanup level.

Surface Soils (0-2 feet bgs)

Two different exposure scenarios were used for calculating cleanup levels in surface soil: a commercial scenario and a residential scenario. The residential scenario considered applies only to properties currently under residential use, and since dioxin/furans were the only compounds detected in residential yards that exceeded screening levels, dioxins/furans are the only compounds for which a residential cleanup level was calculated. Table 3 lists COCs and their corresponding cleanup levels for these two scenarios based on direct contact or soil leaching potential.

Subsurface Soils (greater than 2 feet bgs)
Table 4 lists the COCs for subsurface soil and their corresponding cleanup levels based on direct contact for construction workers or soil leaching potential.

Surface Water and Sediments
As stated previously, limited surface water and sediment samples were collected from the Stillwater River during the comprehensive RI. Dioxins/furans were detected at levels above screening criteria in surface water, but there were no chemicals detected in sediment samples at levels above sediment screening criteria. DEQ contractors conducted additional sampling of the Stillwater River surface water in October 2007. As documented in the Addendum to the FS, this sampling demonstrated that there was no significant difference between dioxin/furan concentrations in the surface water at sample locations throughout the reach of the Stillwater River adjacent to the KRY Site, regardless of flow conditions. Therefore, DEQ has not identified COCs for surface water or sediments at the KRY Site and no additional investigation or cleanup of the river is proposed in this plan.

Ecological Risk Evaluation

The KRY Site is located in an urban industrial/residential area and is unlikely to significantly impact any ecological resources currently or in the future. The main areas of contamination are partially or wholly fenced or covered with weeds. Small rodents and birds may live onsite. These organisms may visit the contaminated areas and inhale dust or ingest contaminated soil periodically. However, there is nothing particularly attractive about the contaminated areas of the KRY Site over the surrounding area that would cause birds or rodents to visit the contaminated areas preferentially. The level of human activity near and throughout the KRY Site is likely to discourage significant usage by wildlife, although an occasional deer or other large mammal may cross the KRY Site. In addition, no designated wetlands exist on or within a mile of the KRY Site. No populations of designated federal or Montana species of concern exist on the KRY Site or surrounding the area and no threatened or endangered species exist primarily within four miles of the KRY Site. Lastly, there is no contamination of the Stillwater River attributable to the KRY Site.

It is DEQ's current judgment that the preferred alternative identified in the Proposed Plan, or another active measure considered in the Proposed Plan, is necessary to protect public health, safety, and welfare and the environment from actual or threatened releases of hazardous or deleterious substances into the environment and to abate the imminent and substantial endangerment those releases pose.

PRELIMINARY REMEDIAL ACTION OBJECTIVES

Preliminary remedial action objectives (PRAOs) are established to allow the identification and screening of remedial alternatives that will achieve protection of public health, safety, and welfare and the environment. The PRAOs for the KRY Site are provided in Table 5.

PRAOs were not developed for surface water or sediment as there are no contaminants of concern present in sediment that exceeded screening levels and recent sampling of the surface water for dioxins/furans shows that there are no impacts attributable to the KRY Site.

SUMMARY AND EVALUATION OF ALTERNATIVES

The Final Draft FS describes the alternatives retained to clean up groundwater and soil at the KRY Site. These alternatives are summarized and evaluated in the following sections using the following cleanup criteria required by statute (Section 75-10-721, MCA):

1. Protectiveness. Overall protection of human health and the environment addresses whether an alternative provides adequate protection in both the short-term and the long-term from unacceptable risks posed by hazardous or deleterious substances present at the KRY Site by eliminating, reducing, or controlling exposure to protective levels.

2. Compliance with environmental requirements, criteria and limitations (ERCLs). This criterion evaluates whether each alternative will meet applicable or relevant state and federal ERCLs.

3. Mitigation of Risk. This criterion evaluates mitigation of exposure to risks to public health, safety, and welfare and the environment to acceptable levels.

4. Effectiveness and Reliability. Each alternative is evaluated, in the short-term and the long-term, based on whether acceptable risk levels are maintained and further releases are prevented.

5. Practicability and Implementability. Under this criterion, alternatives are evaluated with respect to whether this technology and approach could be applied at the site.

6. Treatment or Resource Recovery Technologies. This criterion addresses use of treatment technologies or resource recovery technologies, if practicable, giving due consideration to engineering controls. These technologies are generally preferred to simple disposal options.

7. Cost Effectiveness. Cost effectiveness is evaluated through an analysis of incremental costs and incremental risk reduction and other benefits of alternatives considered. This analysis includes taking into account the total anticipated short-term and long-term costs, including operation and maintenance (O&M) activities.

The first two criteria, protectiveness and compliance with ERCLs, are threshold criteria that must be met in order for a remedy to be selected. The next five criteria are balancing criteria which must be evaluated to provide the best balance in selecting the remedy. The comparison of remedial alternatives for the KRY Site to these criteria is shown on Table 6. In addition to these criteria, DEQ will consider the acceptability of the preferred alternative to the affected community, as indicated by community members and the local government. After the public comment period ends, DEQ will consider any necessary revisions to the preferred remedy in light of the community comments received.

Alternatives Evaluation

Common Elements

All remedial alternatives, except No Further Action, have common elements. These common elements are described here and are not repeated in the descriptions of alternatives that follow. These elements include institutional controls and monitored natural attenuation with long-term monitoring. The following assumptions are provided for the common elements.

Institutional controls. Institutional controls are non-engineering measures, such as administrative or legal controls, that help minimize the potential for human exposure to contamination and protect the integrity of a remedy by limiting land or resource use. Although institutional controls do nothing to remediate the contamination at the site, they are effective for managing human exposure to contaminants. The effectiveness of institutional controls depends on the mechanisms used and the durability of the institutional control. Institutional controls may be layered to improve effectiveness. Institutional controls are considered easy to implement and inexpensive to implement and maintain. Specific institutional controls that may be necessary at the KRY Site are listed below.

> **Land Use Controls:** Additional zoning requirements for the properties that make up the KRY Site may be proposed. DEQ determined reasonably anticipated future use by assessing these four factors: 1) local land and resource use regulations, ordinances, restriction, or covenants; 2) historical and anticipated uses of the facility; 3) patterns of development in the immediate area; and 4) relevant indications of anticipated land use from the owner of the facility and local planning officials. The properties that make up the KRY Site are zoned for commercial/industrial use (with the exception of the residential area, which is likely to remain residential) and have always been used for commercial/industrial purposes. However, the current zoning does allow some limited residential use. Development in the general area is for commercial/industrial use, and due to the availability of residential building sites in other areas of the Flathead Valley, there is unlikely to be additional residential development in the vicinity of the KRY Site. DEQ contacted the owners of the properties that make up the KRY Site to request information about anticipated land use and received word that the properties were expected to remain as commercial/industrial use. Through this assessment, DEQ has determined that the reasonably anticipated future use of the property is commercial/industrial and anticipates requiring restrictive covenants limiting the future use of the property to commercial/industrial as part of the remedy.

Groundwater Use Restrictions: It is anticipated that a controlled groundwater area will be proposed for the KRY Site that would prohibit the installation of drinking water wells until such time as the groundwater meets water quality standards.

Monitored Natural Attenuation(MNA)/Long-Term Monitoring: MNA refers to the reliance on natural processes to breakdown contamination and thereby achieve site-specific remedial objectives within a time that is reasonable compared with the schedule offered by other, more active, methods. Source control measures will be taken to control source materials, as this is the most effective means of ensuring timely attainment of cleanup objectives. The natural attenuation processes, under favorable conditions, and in association with source control or removal, act without human intervention to reduce mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater. These in situ processes include biodegradation; dispersion; dilution; sorption; volatilization; and the chemical or biological stabilization, transformation, or destruction of contaminants. Natural attenuation takes place when naturally occurring microorganisms consume or otherwise degrade contaminants either in the presence or absence of oxygen. Natural attenuation ultimately transforms the contaminants into harmless byproducts such as chloride, carbon dioxide, methane, and water.

Natural attenuation modeling was performed during the FS to aid in evaluation of remedial alternatives. This modeling indicates that MNA alone will not achieve cleanup objectives within a reasonable timeframe. The modeling also suggests that MNA will require a long timeframe (100+ years) to meet cleanup levels in groundwater even after the sources of contamination are removed. Therefore, MNA will be used as a follow-up to other, more aggressive, remediation efforts.

A long-term monitoring program is critical to evaluate the effectiveness of any remediation, MNA included. The long-term monitoring program for the KRY Site will include sampling of any, or all, of the existing monitoring well network that now includes 114 wells (Figure 3). Monitoring may also include some or all of the existing nearby residential wells to ensure that nearby public and private wells do not become contaminated above drinking water standards. At a minimum, monitoring will be conducted on a semi-annual basis for the first five years and annually thereafter, until cleanup levels are achieved.

Alternative 1 – No Action

DEQ compares other options against the baseline No Action Alternative. No further cleanup is considered under this alternative.

Contamination would remain onsite and would continue to impact soil and groundwater. No Further Action is not protective of human health and the environment in the short-term or long-term because people would continue to be exposed to unacceptable levels of contamination in the soil and groundwater and contaminants would continue to leach to groundwater. Groundwater cleanup levels are not expected to be attained under Alternative 1 for over 100 years and, when compared to other alternatives, this is not a reasonable timeframe. Also, free-product would remain on the groundwater and sludge would remain in the soil. Therefore, the No Action Alternative does not comply with ERCLs. Unacceptable risks would remain and risks would not be mitigated. This alternative would not be effective and reliable in the short-term and long-term because unacceptable levels of contamination would remain and contaminants would continue to be released to the environment. This alternative is easily implemented but does not use treatment or resource recovery technologies. The total present worth cost for implementing No Further Action at the KRY Site is $0; however, virtually no risk reduction would occur under this alternative.

Alternative 2 – Multi-Phase Extraction and Disposal

Multi-phase extraction is a combination of bioventing and vacuum-enhanced free-product recovery. A high vacuum system is applied to simultaneously remove various combinations of contaminated groundwater, free-product, and hydrocarbon vapors from subsurface.

Multi-phase extraction and disposal of free-product would significantly reduce the amount of free-product source. Removal of free-product source is an important step in addressing groundwater contamination. Contaminated soil and groundwater would remain at unacceptable levels; therefore, alternative 2 is not protective of human health and the environment. However, this alternative could be used in conjunction with other alternatives and meet the protectiveness criteria. Sludge would remain in the soil and contaminated soil would continue to leach to groundwater causing exceedances of Montana water quality standards. Therefore, this alternative does not meet ERCLs on its own, but could be combined with other alternatives to meet ERCLs. Unacceptable risks would remain and risk would not be mitigated because of residual soil and groundwater contamination. This alternative could be used in conjunction with other alternatives and risks would be mitigated. This alternative is effective and reliable for removing free-product, which would accelerate the cleanup of contaminated groundwater, but other alternatives would be needed to address residual soil and groundwater contamination. This technology is technically and administratively implementable at the KRY Site. The installation of wells and pumps is considered a standard construction practice. This alternative is a proven recovery technology. The total present worth cost for implementing multi-phase extraction and disposal at the KRY Site is $9,910,800. Cost estimates and assumptions are provided in Table 1 of Appendix A.

Alternative 3 – Free-Product Extraction and Disposal

This technology involves removing free-product from wells or trenches under ambient pressure. Free-product can be extracted and disposed of through the use of hydraulic pumps (such as bladder pumps), or with passive or active skimmers.

Free-product extraction and disposal would significantly reduce the amount of free-product source. Removal of free-product source is an important step in addressing groundwater contamination. Contaminated soil and groundwater would remain onsite at unacceptable levels; therefore, alternative 3 is not protective of human health and the environment. However, this alternative could be used in conjunction with other alternatives and meet the protectiveness criteria. Sludge would remain in the soil and contaminated soil would continue to leach to groundwater causing exceedances of Montana water quality standards. Therefore, this alternative does not meet ERCLs on its own, but could be combined with other alternatives to meet ERCLs. Unacceptable risks would remain and risk would not be mitigated because of residual soil and groundwater contamination. However, this alternative could be used in conjunction with other alternatives and risk would be mitigated. This alternative is effective and reliable for removing free-product, which would accelerate the cleanup of contaminated groundwater, but other alternatives would be needed to address residual soil and groundwater contamination. This technology is technically and administratively implementable at the KRY Site. The installation of wells and skimmer pumps is considered a standard practice in the environmental field. This alternative is a proven recovery technology. The total present worth cost for implementing free-product extraction and disposal at the KRY Site is $12,392,100. Cost estimates and assumptions are provided in Table 2 of Appendix A.

Alternative 4 – Extraction, Ex-Situ Treatment and Discharge of Groundwater

A combination of collection, treatment, and discharge, also called pump-and-treat, is used to provide hydraulic containment and to reduce groundwater contaminant levels in a portion of the plume. An extraction system is used to remove contaminated groundwater from the affected aquifer, which is followed by groundwater treatment, if required, and discharge or reinjection of the groundwater into the aquifer or discharge to the surface water. Two types of collection technologies are considered applicable to the KRY Site: extraction wells and collection trenches. Once extracted, ex-situ treatment of groundwater can be accomplished in a number of ways, including bioreactors, among other options. Bioreactors degrade contaminants in water with microorganisms through attached or suspended biological systems.

Ex-situ treatment of groundwater via a bioreactor would significantly reduce the amount of contaminated groundwater at the KRY Site. This alternative would need to be preceded by free-product and contaminated soil removal or treatment. This alternative by itself would not be protective of human health and the environment. The free-product source would remain and sludge in soil and contaminated soil would continue to leach to groundwater causing exceedances of Montana water quality standards. Therefore, this alternative does not meet ERCLs on its own, but could be combined with other alternatives to meet ERCLs. An ex-situ bioreactor uses biological processes to degrade contaminants in groundwater to less harmful compounds. Therefore, there would be some mitigation of risk although free-product, sludge, and residual soil contamination would remain. This alternative is not expected to be effective on dioxins/furans or metals. An activated carbon filter would likely be required to remove additional contaminants prior to discharge. A pilot study would be necessary to evaluate the effectiveness of this alternative at the KRY Site. This technology is technically and administratively implementable at the KRY Site. The equipment and services to install and operate the extraction, treatment, and discharge equipment are commercially available. The use of bioreactors and carbon filters are proven treatment technologies. The total present worth cost for implementing extraction, ex-situ treatment and discharge at the KRY Site is $36,223,000. Cost estimates and assumptions are provided in Table 3 or Appendix A.

Alternative 5 – In-Situ Bioremediation of Groundwater and Soil

Bioremediation is the breaking down of contamination by naturally-occurring organisms present in groundwater and soils. Bioremediation can occur in either aerobic (oxygenated) or anaerobic (minimal amounts of oxygen present) conditions. Aerobic bioremediation can be promoted by the addition of oxygen into a contaminated area. Anaerobic bioremediation can be enhanced by the addition of nutrients.

In-situ bioremediation would significantly reduce contaminant concentrations of petroleum hydrocarbons and PCP in soil and groundwater site-wide. However, this alternative may not address dioxin/furan and metals contamination and will not address free-product on the groundwater and sludge in the soils at the KRY Site. Therefore, contaminants would remain at unacceptable concentrations. This alternative by itself would not be protective of human health and the environment, but could be combined with other alternatives to meet the protectiveness criteria. By itself, this alternative does not meet ERCLs and may not meet ERCLs in combination with other alternatives given the possible resistance of dioxin/furan to bioremediation. In-situ bioremediation uses biological processes to degrade contaminants in groundwater and soil to less harmful compounds. Therefore, there would be some mitigation of risk although free-product, sludge, and residual dioxin/furan contamination would remain in soil and groundwater and metals contamination would remain in soils. Bioremediation has been demonstrated effective on PCP and petroleum hydrocarbons but is not expected to be effective on dioxins/furans or metals. Pilot testing at the KRY Site would be needed to define reaction rates and the types of enhancements needed to improve efficiency. This technology is technically and administratively implementable at the KRY Site. The equipment and services to install and operate the treatment injection system is commercially available. The use of bioremediation via oxygen enhancement is a proven treatment technology. The total present worth cost for implementing in-situ groundwater and soil bioremediation at the KRY Site is $52,272,900. Cost estimates and assumptions are provided in Table 4 of Appendix A.

Alternative 6 – In-Situ Chemical Treatment of Groundwater and Soil

In-situ chemical oxidation involves injection of a chemical oxidant into the groundwater to treat both contaminated groundwater and soil. BNSF is currently using ozone to treat some groundwater leaving the KPT Facility.

In-situ chemical treatment of soil and groundwater would significantly reduce contaminant concentrations of PCP and petroleum hydrocarbons in groundwater and soil site-wide. Based on site-specific data from the operation of an ozonation system installed by BNSF, dioxin/furan concentrations are likely to decrease in groundwater; however, this alternative's ability to treat dioxins/furans in soil is uncertain and it is unlikely that metals contamination in soil would be addressed. Therefore, this alternative by itself is not protective of human health and the environment in the short-term and long-term because people would continue to be exposed to unacceptable levels of contamination in the soil. However, this alternative may be combined with other alternatives to meet the protectiveness criteria. The free-product would remain in groundwater and sludge would remain in soil. Therefore, this alternative does not meet ERCLs on its own, but could be combined with other alternatives to meet ERCLs. Chemical treatment destroys contaminants in groundwater and soil. Therefore, there would be some mitigation of risk although free-product, sludge, and residual dioxin/furan and metals contamination may remain in soil and groundwater. Ozonation has been shown to be effective at treating dissolved petroleum and PCP, and in reducing dioxins/furans at the KRY Site. The amount of ozone required is directly related to contaminant concentrations and other site-specific conditions. Excessive amounts of ozone could hinder biological activity at the KRY Site. Chemical oxidation is unlikely to be effective on metals contamination present at the KRY Site. Chemical oxidants other than ozone are available and may demonstrate different effectiveness in treating COCs. Pilot testing of the other chemical oxidants may be helpful to evaluate their effectiveness at treating the contamination found at the Site. Chemical oxidation is technically and administratively implementable at the KRY Site. In-situ chemical oxidation is a well-established technology used to treat contaminants in groundwater and soils. There may be difficulties with delivery of the oxidant throughout the contaminated soil; therefore, pilot tests would be necessary to optimize design of the system. The technology is currently in use on a portion of the KRY Site. Bench and/or pilot scale testing may be necessary to design a system to address the entire KRY Site. Chemical oxidation is a proven treatment technology. The total present worth cost for implementing in-situ chemical treatment via ozone injection for groundwater and soil at the KRY Site is $14,211,400. Cost estimates and assumptions are provided in Table 5 of Appendix A.

Alternative 7 – Soil Barriers

Soil barriers, also called caps, reduce the infiltration of precipitation through contaminated soils and potentially prevent recharge to groundwater in source areas. An impermeable cap over contaminated soil areas could be constructed of clay, asphalt, concrete, or by using synthetic liners.

Soil barriers would limit the mobility of contamination in the vadose zone. However, contamination would remain in the soil and in site wide groundwater. People could still be exposed to contaminated soil and groundwater. Institutional controls and long-term maintenance would be needed to ensure the integrity of the barrier and prevent direct contact with contamination. Therefore, this alternative by itself is not protective of human health and the environment in the short-term and long-term because free-product would remain and fluctuating groundwater would continue to mobilize contaminants, but could be combined with other alternatives to meet the protectiveness criteria. Alternative 7 would not reach groundwater cleanup levels for over 100 years and, when compared to other alternatives, this is not a reasonable timeframe. Also, free-product would remain on the groundwater and sludge would remain in the soil. Therefore, this alternative does not meet ERCLs on its own, but could be combined with other alternatives to meet ERCLs. This alternative mitigates some direct exposure to contaminated soils, but contamination would remain in soil and continue to impact groundwater. Because fluctuating groundwater would continue to mobilize contaminants from the soil and free-product, this alternative is only somewhat effective. In addition, barriers are susceptible to long-term weathering and may crack, reducing the effectiveness of the barrier. Maintenance of the barrier in perpetuity would be required and land use would be restricted to limit exposure to contamination remaining in the soil. Soil barriers are technically and administratively implementable at the KRY Site. Soil barriers are considered a standard construction practice. Soil barriers provide no form of treatment or resource recovery. The total present worth cost for implementing soil barriers at the KRY Site is $5,599,800. Cost estimates and assumptions can be found in Table 6 of Appendix A.

Alternative 8 – Excavation and Off-site Disposal

Under this alternative, soil would be excavated within the contaminated areas identified at the KRY Site and then disposed of off-site. Excavation and off-site disposal would significantly reduce the amount of contamination in soil. However, free-product and contaminated groundwater would remain. Therefore, this alternative by itself is not protective of human health and the environment in the short-term and long-term, but could be combined with other alternatives to meet the protectiveness criteria. Free-product would remain on the groundwater unless the excavation is deep enough to reach groundwater and free-product is removed during that process. In addition, some soil contains a RCRA listed hazardous waste (F032) that is precluded from land disposal; therefore, it would have to be taken to an incinerator. This alternative does not meet ERCLs on its own, but could be combined with other alternatives to meet ERCLs. Excavation would remove all contaminants in the soil that exceed acceptable levels, including sludge, lead, and dioxins/furans. Therefore, there would be some mitigation of risk although contaminated groundwater and possibly free-product would remain. This alternative is considered highly effective at removing contaminated soil in the vadose zone up to 30 feet below ground surface. Because waste would be disposed of at a licensed engineered off-site facility, regulatory requirements for the off-site disposal facility would effectively control the contamination. Excavation and off-site disposal is technically and administratively implementable at the KRY Site. The equipment and services to remove and transport the contaminated soil are commercially available. This alternative includes some treatment and some resource recovery technologies. The total present worth for implementing excavation and off-site disposal at the KRY Site is $120,950,900. Cost estimates and assumptions can be found in Table 7 of Appendix A.

Alternative 9 – Excavation, Ex-Situ Treatment, and Backfill

Under this alternative, soil would be excavated within the identified remediation areas at the KRY Site. Excavation, ex-situ treatment, and backfill would significantly reduce the amount of contamination in soil. However, free-product and contaminated groundwater would remain unless the excavation is deep enough to reach groundwater and free-product is removed during that process. Therefore, this alternative by itself is not protective of human health and the environment in the short-term and long-term, but could be combined with other alternatives to meet the protectiveness criteria. In addition, some soil contains a RCRA listed hazardous waste that would require special handling for onsite treatment. This alternative does not meet ERCLs on its own, but could be combined with other alternatives to meet ERCLs. Excavation would remove all contaminants in the soil that exceed acceptable levels, including sludge, lead, and dioxins/furans. Subsequent ex-situ treatment would reduce the toxicity and volume of some contaminants in the soil. It is uncertain if ex-situ treatment will reduce dioxin/furan concentrations to acceptable levels. Therefore, there would be some mitigation of risk, although contaminated groundwater and possibly free-product would remain. If contaminated soil is treated to cleanup levels it would be available for use as backfill material at the KRY Site. This alternative is considered highly effective at removing contaminated soil in the vadose zone up to 30 feet below ground surface. However, the effectiveness of ex-situ treatment on dioxin/furan contamination is uncertain. This alternative may need to be combined with other alternatives. Excavation and ex-situ treatment is technically and administratively implementable at the KRY

Site. The equipment and services to remove and treat the contaminated soil are commercially available. The use of ex-situ soil treatment is a proven treatment technology. The total present worth for implementing excavation, ex-situ treatment (using engineered land treatment unit) and backfill using treated soil at the KRY Site is $8,469,985. Cost estimates and assumptions can be found in Table 8 of Appendix A. Should the treated soil not provide enough volume to fill the excavations, some additional costs may be incurred to purchase clean soil to adequately fill the excavations.

Comparative Analysis

The alternatives were evaluated and compared against the seven cleanup criteria identified in 75-10-721, MCA (Table 6). Protectiveness and compliance with ERCLs are threshold criteria that must be met for any remedy. In the comparative analysis, the remaining criteria are weighed and evaluated to identify the best overall alternatives for each media. Each criterion is listed individually below. A list of the alternatives and their corresponding numbers is also provided to aid in this analysis.

- Alternative 1: No Action
- Alternative 2: Multi-Phase Extraction and Disposal
- Alternative 3: Free-Product Extraction and Disposal
- Alternative 4: Extraction, Ex-Situ Treatment and Discharge
- Alternative 5: In-Situ Bioremediation of Groundwater and Soil
- Alternative 6: In-Situ Chemical Treatment of Groundwater and Soil
- Alternative 7: Soil Barriers
- Alternative 8: Excavation and Off-site Disposal
- Alternative 9: Excavation, Ex-Situ Treatment, and Backfill

Protection of public health, safety, and welfare and the environment (Protectiveness)

Alternative 1, 2, and 3 would not provide adequate protection of public health, safety, and welfare and the environment in the short-term or long-term because people would continue to be exposed to unacceptable levels of contamination in the soil and contaminants would continue to leach to groundwater. However, alternatives 2 and 3, if combined with soil and groundwater alternatives, may provide adequate protection in the long-term. Alternatives 4 through 9 cannot provide adequate protection in the short-term and long-term unless multiple alternatives are combined to address the risks posed by all of the contaminated media at the KRY Site. For instance, alternatives 2 or 3 could be combined with alternatives 5 or 6 to be protective. It may also be possible to combine alternatives 2 or 3 with some combination of alternatives 4, 7, 8, and 9 to ensure protectiveness. Institutional controls and monitoring would be necessary for short-term and long-term protectiveness no matter what alternatives are selected. Alternatives 1 and 7 as stand alone options would not provide adequate protection for over 100 years. Alternatives 2, 3, 8, and 9 as stand alone options would likely not provide adequate protection for 40 to 100 years. Alternatives 4, 5, and 6 would likely not provide adequate protection for 10 years. However, the timeframe could be drastically reduced for some of these alternatives, specifically 2, 3, 8, and 9, if they are used in conjunction with other alternatives.

Compliance with ERCLs

None of the alternatives used alone will comply with ERCLs. Alternative 1 is not expected to reach groundwater cleanup levels for more than 100 years. When compared to other alternatives this is not a reasonable timeframe. Therefore, Alternative 1 does not meet ERCLs. Alternatives 2 through 9 will comply with ERCLs when combined with other alternatives. Any combination of alternatives that would remove free-product to the maximum extent practicable, reduce groundwater concentrations to levels that meet Montana water quality standards, and treat PCP contaminated soils that are banned from land disposal to site-specific cleanup levels, including leaching to groundwater numbers, would comply with ERCLs. Alternatives 1 and 7 as stand alone options would not meet ERCLs for over 100 years. Alternatives 2, 3, 8, and 9 as stand alone options would likely not meet ERCLs for 40 to 100 years. Alternatives 4, 5, and 6 would likely not meet ERCLs for 10 years. However, the timeframe could be drastically reduced for some of these alternatives, specifically 2, 3, 8, and 9, if they are used in conjunction with other alternatives.

Mitigation of Risk

None of the alternatives used alone mitigate all risks. Under Alternative 1, free-product, sludge in soil, and contaminated soils and groundwater would remain at the KRY Site. Unacceptable risk would exist and would not be mitigated by this alternative. Alternatives 2 and 3 do not mitigate risk because residual sludge, soil, and groundwater contamination would remain. Some mitigation of risk would occur as a result of removing free-product that continues to release contaminants to groundwater. Alternative 4 mitigates some risks posed by groundwater contamination because it treats contaminated groundwater. However, it does not mitigate risk associated with sludge in soil at the Reliance Facility, free-product on the groundwater, or soil contamination. Alternative 5 mitigates some risks because it treats PCP and petroleum contamination in soil and groundwater. However, it is unlikely that this alternative would be effective at treating free-product, sludge, dioxins/furans or metals and therefore would not mitigate risk associated with those compounds. Alternative 6 mitigates some risks because it treats PCP, petroleum and may treat dioxins/furans. It would not effectively treat free-product, sludge or metals. Alternative 7 mitigates some direct exposure to contaminated soils but contamination would remain in soil and fluctuating groundwater would continue to mobilize contaminants from soil and free-product. Institutional controls and long-term maintenance would be needed to ensure the integrity of the barrier and prevent direct contact with contamination. Alternative 8 would mitigate risks posed by contaminated soils because they would be excavated and removed from the KRY Site. Also, if the excavation is not deep enough and no free-product is recovered, then contaminated groundwater would remain and people may be exposed to contaminants. Alternative 9 would mitigate some risk because all contaminants in the soil would be removed and treated. However, it is uncertain if this alternative will reduce dioxin/furan concentrations to acceptable levels.

Effectiveness and Reliability in the Short-Term and Long-Term

None of the alternatives alone are effective and reliable at addressing all of the COCs and contaminated media. Alternative 1 is not effective and reliable in the short-term and long-term because unacceptable levels of contamination would remain and contaminants would continue to be released to the environment. Alternatives 2 and 3 are effective and reliable for removing free-product but other alternatives would be needed to address residual soil and groundwater contamination. Alternative 4 would be effective on some contaminants at the KRY Site, but is not expected to be effective on dioxins/furans or metals. Additional treatment would likely be required. A pilot study would be necessary to better evaluate the effectiveness of this alternative. Alternative 5 would be effective for PCP and petroleum, but is not expected to be effective for treating dioxins/furans or metals. Pilot testing would be needed to define reaction rates and identify enhancements that would be needed to improve efficiency. Site-specific tests demonstrate that ozonation, which could be a component of Alternative 6, is effective at treating dissolved petroleum, PCP and to a limited extent dioxins/furans. However, it is unlikely to be effective on metals contamination or free-product. It is also uncertain if this alternative would achieve dioxin/furan cleanup levels in soils and groundwater. Pilot testing would be needed to determine the effectiveness of this alternative on soils at the KRY Site and to evaluate the effectiveness of other oxidants. Alternative 7 is somewhat effective at preventing people from directly contacting contaminated soils. Barriers are susceptible to weathering and may crack, reducing the effectiveness of the barrier in the long-term. Maintenance of the barrier in perpetuity would be required. Because contaminated soil would remain and fluctuating groundwater would continue to mobilize contaminants, this alternative is not effective on its own for free-product and site wide groundwater contamination. Alternative 8 is effective in the short-term and long-term at removing contaminated soil up to 30 feet below ground surface. Because contaminated soil would be disposed of at a licensed engineered off-site facility, regulatory requirements for the off-site facility would effectively control contaminants in the long-term. This alternative by itself is not effective for treating free-product or groundwater contamination. Alternative 9 is effective in the short-term and long-term at removing contaminated soil up to 30 feet below ground surface. Subsequent ex-situ treatment would reduce the toxicity and volume of some contaminants in the soil. The effectiveness of ex-situ treatment at reducing dioxin/furan concentrations to acceptable levels is uncertain. This alternative by itself is not effective for treating free-product, unless it is removed as part of the excavation process, or groundwater contamination.

Technically Practicable and Implementable

All the alternatives are technically practicable and implementable at the KRY Site.

Treatment Technologies or Resource Recovery Technologies (Giving due consideration to engineering controls)

Alternatives 1 and 7 do not use treatment or resource recovery technologies. The remaining alternatives include some form of treatment or resource recovery technology. Any alternative that requires onsite treatment will likely require fencing of portions of the KRY Site to ensure protection of human health in the short-term.

Cost Effectiveness

Alternatives 1 through 4 are less costly than the other alternatives (see Table 6). However, alternatives 1 through 4 by themselves do not sufficiently reduce risks associated with contaminated soils. Alternative 5 or Alternative 6 combined with either free-product recovery alternative (2 or 3) provides substantial risk reduction and requires less long-term care than Alternative 7. Alternatives 5 and 6 are less costly than Alternative 8 but require more operation and maintenance and provide less risk reduction. Alternative 7 provides for risk reduction by preventing direct contact with contaminated soils. However, it does not reduce risk associated with free-product or contaminated groundwater. Long-term costs associated with Alternative 7 are included in the estimated cost. Next to Alternative 1, Alternative 7 is the least costly alternative. However, with the exception of Alternative 1, Alternative 7 also provides the least amount of risk reduction. Alternative 8 combined with Alternative 4, or the groundwater component of Alternatives 5 or 6, and either free-product recovery alternative (2 or 3) provides greater risk reduction than other alternatives, but any of these alternatives combined with Alternative 8 are the most costly. Alternative 9 combined with Alternative 4, or the groundwater component of Alternatives 5 or 6, and either free-product recovery alternative (2 or 3) provides substantial risk reduction and requires less long-term care than Alternative 7.

Scope of the Preferred Remedy

DEQ's preferred remedy for the KRY Site is a combination of Alternative 3 (free-product extraction and disposal), Alternative 6 (chemical oxidation), Alternative 8 (excavation and offsite disposal), Alternative 9 (excavation, ex-situ treatment, and backfill), and possibly Alternative 7 (soil barriers). The preferred remedy also includes institutional controls and long-term monitoring. Costs and assumptions used in calculating the total present value of these common elements are provided along with other cost tables in Appendix B. DEQ has determined that the preferred remedy would satisfy the statutory requirements in Section 75-10-721, MCA. However, the preferred remedy may be revised in response to public comment or new information.

The Preferred Remedy

Some interim actions have been conducted, as discussed previously, which helped reduce the threat to public health, safety, and welfare and the environment. These interim actions have contributed to the preferred remedy because they reduced contaminant concentrations in some areas. The preferred remedy expands an existing treatment system that BNSF installed on a portion of the KRY Site.

This section describes remedial actions necessary to complete cleanup at the KRY Site. Pilot tests for specific technologies and schedules for the preferred remedy will be described in the ROD. Engineering and design details will be specified in the Remedial Design documents to be issued after the ROD.

DEQ selected a combination of alternatives to cleanup soil and groundwater and address free-product. These include free-product recovery methods (trenches and/or recovery wells) for more mobile free-product on groundwater and excavation for less mobile free-product, chemical oxidation for treatment of the dissolved organic-COC plume in groundwater, MNA for inorganics and petroleum in groundwater, excavation of contaminated soils combined with ex-situ treatment and off-site disposal, potential capping, institutional controls, and long-term monitoring.

Pilot testing will be required to optimize the design of the various components of the remedy. Certain components of the remedy must happen before other components can begin. Therefore, the preferred remedy will be implemented using a phased approach. This phased approach will be built into the Remedial Design document to be issued after the ROD.

Soil

Excavation of contaminated soils, in combination with stabilization, off-site disposal/recycling, and ex-situ bioremediation in a land treatment unit (LTU) will reduce contaminant concentrations to levels that no longer pose a risk for leaching to groundwater. Additionally, these activities would eliminate the direct contact risk to workers in a commercial/industrial scenario. The following is a discussion of the components of the soil portion of the preferred remedy:

Excavation of Contaminated Soils and Sawdust
The preferred remedy would require excavation of contaminated soils and sludges (Figures 6 and 7) throughout the KRY Site. This excavation would be completed in a phased approach to ensure that various contaminants are segregated as they will be handled differently. Methods of stabilizing the excavation sites will be employed. Any debris encountered during excavation would be disposed of properly and utilities would be located and avoided, protected, or relocated. Sawdust will be excavated until there are no visible signs of sawdust within the soil.

Stabilization of Lead Contaminated Soils
Approximately 2,200 cubic yards of lead-contaminated soil exists at the Reliance Facility (Figures 6 and 7). The preferred remedy includes excavation and disposal of the lead-contaminated soils at an offsite disposal facility. Some of the lead-contaminated soil may require stabilization to reduce toxicity and leachability before disposal can occur. Characterization sampling and a treatability study may be required prior to the design phase and disposal.

Recycling of Petroleum Sludge
An estimated 3,126 cubic yards of petroleum sludge is present throughout the Reliance Facility (Figure 8), both at the surface and at depth. The sludge exists in varying degrees of viscosity and is intermixed with debris or soil. The sludge will be recycled, possibly in an asphalt batch plant. Some sludge is present in surface "pits," which may be easily recyclable. However in some places, debris is mixed with the sludge, which might preclude recycling of the product. Other areas of sludge are intermixed with soils, and would not be easily separated. Sludge material that

is not able to be recycled will be disposed of at an off-site facility. Some stabilization or solidification may be required for this option. Sludge material that is intermixed with soil that cannot be recycled will be treated along with other petroleum contamination in an LTU. Characterization sampling and a treatability study may be required prior to the design phase and disposal.

Ex-situ Bioremediation of Soils using LTUs
The majority of excavated soils will be treated through bioremediation in an LTU. It is expected that two LTUs will be constructed at the KRY Site: one for petroleum contaminated soils and the other for PCP and dioxin/furan contaminated soils. The estimated treatment timeframe for PCP-contaminated soils based on the average detected PCP concentration at the KRY Site is 9 years. However, this does not take into account the addition of water and nutrients, which will likely significantly decrease the treatment timeframe. Petroleum constituents and polycyclic aromatics hydrocarbons (PAHs) are more easily treated through bioremediation than PCP, and therefore will have quicker treatment timeframes. However, dioxins/furans may not be effectively treated to cleanup levels through bioremediation. If after treatment, soils contain dioxins/furans above cleanup levels, the treated soil will be placed in a repository and capped. Without the presence of a carrier solution, the dioxins/furans would not leach to groundwater. An appropriate cap would be required to mitigate the direct contact risk. Institutional controls (which may include zoning and restrictive covenants), engineering controls, and long-term maintenance would be needed so the cap would not be compromised.

Figure 9 shows the conceptual locations and design of the two LTUs for the KRY Site that was used for cost estimating purposes. The LTU at the Reliance Facility would be used for petroleum-contaminated soils and the LTU at the KPT Facility would be used for treating the PCP and dioxin/furan-contaminated soils. The LTUs would be lined with a reinforced polypropylene (RPP) liner and leachate collection systems would be included. Leachate would be recycled and used for irrigation of the LTU (in combination with other water sources). Additionally, nutrients and water would be added to enhance biodegradation within the LTUs. Bench scale testing or pilot testing would be required to optimize system design.

Groundwater

Natural attenuation modeling was performed during the FS to aid in evaluation of remedial alternatives. This modeling demonstrated that with complete PCP and dioxin/furan source removal (both free-product and contamination in the soil overlying the groundwater), it will take approximately 40 years for the PCP plume to meet the groundwater cleanup level, and more than 100 years for the dioxin/furan plume to meet the groundwater cleanup level. This timeframe is not reasonable given that alternatives exist to actively treat the groundwater plume to speed up the cleanup process. Removing contamination from soil, in combination with active treatment of the contaminated groundwater plume and free-product recovery, would help achieve established groundwater cleanup levels. The following is a discussion of the components of the groundwater portion of the preferred remedy:

Free-Product Removal

Removal of free-product from groundwater is an important step in meeting groundwater cleanup levels. As mentioned in previous sections, there are two types of free-product on groundwater at the KRY Site. A lighter, more mobile product that contains PCP (and therefore is considered RCRA listed hazardous waste) is present on the KPT Facility, while a much more viscous product is present at the Reliance Facility (Figure 10). The heavy, viscous product present at the Reliance Facility is not very mobile and is present in the vicinity of low-permeability soils, and therefore may be difficult to recover using recovery methods like trenches and/or wells. Free-product recovery technologies like trenches and/or wells will likely be effective at removing the lighter product present at the KPT Facility.

The preferred remedy would utilize free-product recovery methods such as trenches and/or recovery wells, or a combination of the two, to remove the free-product from the groundwater at the KPT Facility. Pilot tests are necessary to optimize the system design. Free-product recovery methods are unlikely to be efficient at removing free-product at the Reliance Facility due to its viscous nature and the presence of product in areas of low permeability soils. The free-product at the Reliance Facility is more localized than that at the KPT Facility. Therefore, this product will be excavated along with contaminated soils present at the Reliance Facility to ensure adequate removal of the source.

Free-product must be removed from the groundwater to the maximum extent practicable, which DEQ has determined to be 1/8 inch or less. Free-product from the Reliance Facility will be recycled. Free-product from the KPT Facility will be disposed of at an off-site facility as a RCRA listed hazardous waste due to the presence of PCP in the free-product.

Chemical Oxidation of Contaminated Groundwater Plume

In-situ chemical treatment of groundwater would significantly reduce contaminant concentrations of PCP and petroleum hydrocarbons in groundwater. Data from the operation of the ozonation system currently operating at the KPT Facility demonstrates that dioxin/furan concentrations are likely to decrease in groundwater, which will decrease the overall treatment timeframe (modeled at 100 years). However, given the characteristics of dioxins/furans, a hard to cleanup compound, the ability of chemical oxidation to treat dioxins/furans to the cleanup level listed on Table 2 is uncertain. If the chemical oxidation treatment of the dioxin/furan plume is unable to achieve dioxin/furan cleanup levels, and the plume is stable, then the dioxin/furan plume will revert to monitored natural attenuation and will continue to be sampled as part of the long-term monitoring program.

The preferred remedy would expand the current in-situ chemical oxidation system using ozone gas as the oxidant of choice. Figure 11 shows the conceptual design of the chemical oxidation system used for cost estimation purposes. The ozone gas would be injected into the groundwater throughout the PCP and dioxin/furan plumes associated with the KPT Facility. If dissolved petroleum contamination is present in this area, the chemical oxidation system will also be effective in treating that contamination. The chemical oxidation system would inject ozone on a cyclical basis and would remain in place for approximately ten years. It may be possible to use another oxidant, persulfate, in place of ozone, as it has higher oxidizing potentials, which makes it more effective at treating difficult-to-treat compounds such as dioxins/furans. However, persulfate is more expensive to use and is a liquid solution as opposed to a gas, meaning the delivery mechanism for injection would have to be modified. Pilot testing, which may include testing of other chemical oxidants, will be conducted to optimize system design.

Monitored Natural Attenuation for Petroleum and Metals

High concentrations of petroleum compounds currently exist in groundwater at the Reliance Facility and in limited areas at the KPT Facility (Figure 5). However, this contamination is closely tied to the presence of free-product in contact with the groundwater. Therefore, it is assumed that removal of the free-product and overlying contaminated soil will significantly decrease the petroleum concentrations in groundwater over time. The preferred remedy would rely on excavation of contaminated soils and removal of free-product on groundwater to eliminate the source of the dissolved-phase petroleum contamination. Regular sampling as part of the long-term groundwater monitoring program would measure the predicted decline in the petroleum concentrations in groundwater at the KRY Site.

High levels of iron, manganese, and arsenic exist in the groundwater near the source areas at both the KPT and Reliance Facilities (Figures 12A, 12B, and 12C). These high levels of metals are likely due to the breakdown of free-product in these areas. Another area of high concentrations of iron and manganese exists in the vicinity of well KRY-103A, on the northwestern edge of the KPT Facility. These increased concentrations may be related to the presence of the buried sawdust in this area, which is decomposing. At the Reliance Facility, the preferred remedy relies on excavation of contaminated soils to remove the source of the contamination, which should remedy the metals issue in groundwater over time. At the KPT Facility, excavation of contaminated soils in the source area and the sawdust will decrease the high concentrations of metals in groundwater over time. The excavated sawdust material can then be used as an amendment to the soils that will be treated in the LTUs to enhance biodegradation of contaminated soils. Regular sampling as part of the long-term groundwater monitoring program would measure the decline in the metals concentrations in groundwater at the KRY Site.

Long-Term Monitoring

Monitoring would include sampling of any, or all, of the existing monitoring well network that now includes 114 wells or additional wells that may be installed as part of remedial design. At a minimum, monitoring will also include existing nearby domestic wells that DEQ sampled quarterly in 2006-2007. The monitoring wells and other wells that will be included in the long-term monitoring network will be determined in the remedial design phase after the ROD is issued. At a minimum, monitoring will be conducted on a semi-annual basis for the first five years and annually thereafter, until cleanup levels are achieved. Should detections of contaminants occur in domestic wells at levels at or in excess of drinking water standards, DEQ will require immediate resampling of the well. Should the initial detected concentration be verified, DEQ will require immediate connection of the residence or business to the public water supply provided through the Evergreen Water District.

Controlled Groundwater Area

To protect human health and limit migration of contaminants through pumping, the remedy would partially rely on institutional controls in the form of a controlled groundwater area to ensure that no additional wells are installed within or adjacent to the area of contamination associated with the KRY Site (Figure 5). While there are domestic use wells currently in operation in the vicinity of the KRY Site, the Evergreen Water District supplies public water to homes and businesses in the area. Therefore, prohibition of additional wells is expected to be accepted by the affected community since an additional source of water is available.

The total present worth value of the preferred remedy is $28,496,174. Cost assumptions and tables for all components of the preferred remedy are provided in Appendix B.

Evaluation of the Preferred Remedy for Soil and Groundwater

The preferred remedy would remove contamination from soil using a combination of excavation, recycling, off-site disposal, and bioremediation (with a capping contingency) and will remove contamination from groundwater using a combination of excavation, free-product recovery, in-situ chemical oxidation, and monitored natural attenuation. Institutional controls in the form of a controlled groundwater area, zoning, and/or restrictive covenants limiting the future use of the property to commercial/industrial uses are also included in the preferred remedy. The remedy also includes long-term groundwater monitoring to confirm the effectiveness of the remedial actions and ensure nearby public and private wells do not become contaminated above drinking water standards.

The preferred remedy for soil was selected over other alternatives because it is expected to achieve substantial and long-term risk reduction through excavation and treatment, and is expected to allow the property to be used for the reasonably anticipated future land use, which is commercial/industrial. The preferred remedy for groundwater was selected over the other alternatives because it is expected to achieve substantial risk reduction through removal of free-product, treatment of contaminants in the groundwater and provides measures to prevent future exposures to currently contaminated groundwater. The preferred remedy reduces the risk within a reasonable timeframe and is cost-effective because it attains the highest level of risk reduction compared to cost. The preferred remedy provides for long-term reliability of the remedy.

Based on the information available at this time, DEQ believes the preferred remedy is protective of public health, safety, and welfare and the environment, would comply with ERCLs, would mitigate risk, would be effective in the short- and long-term, is practicable and implementable, uses treatment and resource recovery technologies, and is cost-effective. Because it would treat the source materials, the remedy also would meet the statutory preference for the selection of a remedy that involves treatment as a principle element. The preferred remedy may be revised in response to public comment or new information.

Tables

TABLE 1
SUMMARY OF AQUIFER TEST RESULTS
KRY SITE

Well Number	Well Diameter (inches)	Aquifer Zone[1]	Aquifer Thickness (feet)	Test Date	Test Type Conducted	Test Duration (minutes)	Pumping Rate (gpm)	Maximum Drawdown (feet)	Solution Method	Transmissivity (ft^2/day)	Hydraulic Conductivity (ft/day)
KRY108A	2	Upper Unconfined	91	8/21/06	Pumping Well Drawdown	94	6.1	0.03	NC [2]	NC [2]	NC [2]
KRY113B	2	Lower Unconfined	91	8/21/06	Pumping Well Drawdown	112	6.1	1.1	Theis Unconfined	5,500	60
KRY121A	2	Upper Unconfined	106	8/18/06	Pumping Well Drawdown	56	6.1	0.1	NC [2]	NC [2]	NC [2]
KRY121B	4	Lower Unconfined	106	8/16/06	Pumping Well Drawdown	42	30	1.1	Theis Unconfined	34,600	326
KRY139A	4	Upper Unconfined	164	8/22/06	Pumping Well Drawdown	105	5.8	2.97	Theis Unconfined	2,800	17
KRY139A	4	Upper Unconfined	14.6[3]	8/22/06	Pumping Well Recovery	15	5.8	2.97	Theis Confined	138	9
KRY139B	2	Lower Unconfined	164	8/22/06	Pumping Well Drawdown	84	6.1	1.3	Theis Unconfined	8,941	55

Notes:
(1) Upper Unconfined refers to wells completed in upper portion of unconfined aquifer. Lower Unconfined refers to wells completed in lower portion of unconfined aquifer.
(2) NC = not calculated Aquifer tests at wells KRY108A and KRY121A yielded insufficient drawdown to complete the analysis.
(3) Calculation of transmissivity and hydraulic conductivity used the length of the saturated portion of the well screen.

Solution Methods: Theis (1935)
Gpm Gallons per minute ft^2/d Feet squared per day

Table 2
Groundwater Cleanup Levels
KRY Site

Contaminant of Concern	Cleanup Level (ug/L)	Background	DEQ-7 Standard	RBCA RBSL	Tap Water PRG
1,2,4-Trimethylbenzene	12				X
1,3,5-Trimethylbenzene	12				X
Arsenic	10		X		
Benzene	5		X	X	
C11-C22 Aromatics	1000			X	
C5-C8 Aliphatics	800			X	
C9-C10 Aromatics	1000			X	
C9-C12 Aliphatics	500			X	
Dioxins/furans (TEQ - WHO 1998)	5.58 pg/L	X			
Ethylbenzene	700		X	X	
Iron	300		X		
Manganese	778	X			
Naphthalene	100		X	X	
n-Butylbenzene	240				X
Pentachlororphenol	1		X		
Toluene	1000		X	X	
Free-product	1/8 inch*				

ug/L - microgram per liter (parts per billion)
pg/L - picograms per liter (parts per quadrillion)
* - See preferred remedy section of the Proposed Plan for more information

Table 3
Surface Soil Cleanup Levels
KRY Site

Contaminant of Concern	Commercial/Industrial Cleanup Level (mg/kg)	Residential Cleanup Level (ng/kg)
Aluminum	120,209	NA
Arsenic	40[1]	NA
Benz(a)anthracene	1.7[2]	NA
Benzo(a)pyrene	1.7[2]	NA
Benzo(b)fluoranthene	1.7[2]	NA
C11-C22 Aromatics	33,445	NA
C9-C18 Aliphatics	2,107	NA
Chromium	150	NA
Dibenzo(a,h)anthracene	1.7[2]	NA
Dioxins/furans (TEQ - 2005)	89 ng/kg	54
Indeno(1,2,3-cd)pyrene	1.7[2]	NA
Iron	46,686	NA
Lead	800	NA
Methylene Chloride	0.82	NA
Pentachlororphenol	12[3]	NA

mg/kg - milligrams per kilogram (parts per million)
ng/kg - nanograms per kilogram (parts per trillion)
Cleanup levels in bold are based on leaching to groundwater
[1] - DEQ Action Level from DEQ's April 2005 Arsenic Position Paper
[2] - cPAHs include benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, debenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene for surface soils
[3] - Cleanup level unless subsurface soil is contaminated in same area, then it would be 0.43 mg/kg
[4] - Dioxins/furans were the only COC for residential soil
NA - Not applicable

Table 4
Subsurface Soil Cleanup Levels
KRY Site

Contaminant of Concern	Cleanup Level (mg/kg)
Acenaphthene	27,000
Aluminum	120,209
Arsenic	40[1]
Benz(a)anthracene	13[2]
Benzo(a)pyrene	13[2]
C11-C22 Aromatics	33,445
C19-C36 Aliphatics	260,154
C5-C8 Aliphatics	584
C9-C10 Aromatics	4,800
C9-C12 Aliphatics	1,240
C9-C18 Aliphatics	2,107
Carbazole	99
Chromium	20
Dioxins/furans (TEQ - 2005)	736 ng/kg
Ethylbenzene	320
Fluorene	130,000
Iron	46,686
Lead	800
2-Methylnaphthalene	1,982
Naphthalene	220
Pentachlorophenol	0.43
Selenium	1.7
Toluene	260
Xylenes	389
Sawdust*	Visual

mg/kg - milligrams per kilogram (parts per million)
ng/kg - nanograms per kilogram (parts per trillion)
Cleanup levels in bold are based on leaching to groundwater
[1] - DEQ Action Level from DEQ's April 2005 Arsenic Position Paper
[2] - cPAHs include benz(a)anthracene and benzo(a)pyrene for subsurface soils
* - See preferred remedy section of the Propsoed Plan for more information

Table 5
Preliminary Remedial Action Objectives
KRY Site

For Groundwater:

1) Meet groundwater cleanup levels for COCs in groundwater throughout the KRY Site.
2) Comply with ERCLs for free-product and COCs in groundwater.
3) Reduce potential future migration of free-product and contaminated groundwater plume.
4) Prevent exposure of humans to free-product and to COCs in groundwater at concentrations above cleanup levels.

For Soil:

1) Prevent migration of COCs that would potentially leach from soil to groundwater.
2) Prevent exposure of humans to free-product and to COCs in soil at concentrations above cleanup levels.
3) Meet soil cleanup levels for COCs.
4) Comply with ERCLs for free-product in soil.

Table 6
Analysis of Alternatives
KRY Site

Alternatives	Protectiveness	Compliance with ERCLs	Mitigation of Risk	Effectiveness and Reliability	Implementability and Practicability	Treatment or Resource Recovery Technologies	Present Cost at 3% Over 100 Years
1 - No Action	No	No	No	No	Yes	No	$ -
2 - Multi-Phase Extraction and Disposal	Yes (when combined)	Yes (when combined)	Yes (when combined)	Yes (for LNAPL)	Yes	Yes	$ 9,910,800
3 - LNAPL Extraction and Disposal	Yes (when combined)	Yes (when combined)	Yes (when combined)	Yes (for LNAPL)	Yes	Yes	$ 12,392,100
4 - Extraction, Ex-Situ Treatment, and Discharge of Groundwater	Yes (when combined)	Yes (when combined)	Yes (Groundwater contamination) No (LNAPL, sludge, soil contamination)	Yes (for petroleum and PCP) No (for dioxins/furans and metals)	Yes	Yes	$ 36,223,000
5 - In-Situ Bioremediation of Groundwater and Soil	Yes (when combined)	Yes (when combined)	Yes (PCP and petroleum) No (LNAPL, sludge, dioxin/furan and metals)	Yes (PCP and petroleum) No (dioxin/furans and metals)	Yes	Yes	$ 52,272,900
6 - In-Situ Chemical Treatment of Groundwater and Soil	Yes (when combined)	Yes (when combined)	Yes (PCP and petroleum) No (LNAPL, sludge, dioxin/furan, metals)	Yes (PCP and petroleum) No (metals) Maybe (dioxins/furans)	Yes	Yes	$ 14,211,400
7 - Soil Barriers	Yes (when combined)	Yes (when combined)	Yes (when combined)	Yes (when combined)	Yes	No	$ 5,599,800
8 - Excavation, Off-Site Disposal	Yes (when combined)	Yes (when combined)	Yes (for soils) No (for LNAPL and groundwater)	Yes (for soils)	Yes	No	$120,950,900
9 - Excavation, Ex-Situ Treatment, and Backfill	Yes (when combined)	Yes (when combined)	Yes (for soils) No (for LNAPL and groundwater) Maybe (dioxin)	Yes (when combined)	Yes	Yes	$8,469,985.00
Preferred Alternative	**Yes**	**YES**	**YES**	**YES**	**YES**	**YES**	**$28,496,173.99**

Appendix A

TABLE F-1
Preliminary Cost Estimate
LNAPL
Multiphase Extraction and Disposal
KRY Site

CAPITAL COSTS							
Item	Unit		Unit Cost	Quantity		Cost	Source of Cost Data
Bio-Slurping System: Kalispell Pole Treatment Site	well	$	11,953.08	26	$	310,780	RACER
Carbon Adsorption System: Kalispell Pole Treatment Site	gpm	$	504.51	130	$	65,586	RACER
Bio-Slurping System: Reliance Refinery Site	ls	$	11,625.35	20	$	232,507	RACER
Carbon Adsorption System: Reliance Refinery Site	well	$	429.99	100	$	42,999	RACER
Treated Water Combined Discharge Pipeline	ls	$	43,788.00	1	$	43,788	RACER
Residual Waste Management	ls	$	8,128.00	1	$	7,804	RACER
Overhead Electical Distribution System	ls	$	34,874.00	1	$	23,962	RACER
				SUBTOTAL	**$**	**727,430**	
Construction Contingencies	25%				$	181,858	10% Scope, 15% Bid
				SUBTOTAL	**$**	**909,290**	
Project Management	6%				$	54,557	EPA Cost Guidance
Remedial Design including Pilot Testing	12%	plus $150,000.00			$	259,115	EPA Cost Guidance
Construction Management	8%				$	72,743	EPA Cost Guidance
				SUBTOTAL	**$**	**386,420**	
				TOTAL CAPITAL COSTS	**$**	**1,295,710**	

ANNUAL OPERATION AND MAINTENANCE (O&M) COSTS							
Item	Unit		Unit Cost	Quantity		Cost	Source of Cost Data
Site Maintenance	ls	$	36,371.50	1	$	36,372	Engineer Estimate
Site Operation	ls	$	106,064.00	1	$	106,064	RACER
Power Kalispell Pole Treatment Site	kwh	$	0.08	377045	$	30,164	RACER
Carbon Replacement Kalispell Pole Treatment Site	lb/yr	$	1.81	594	$	1,075	RACER
Power Reliance Refinery Site	kwh	$	0.08	307621	$	24,610	RACER
Carbon Replacement Reliance Refinery Site	lb/yr	$	1.81	457	$	827	RACER
LNAPL Disposal	gal	$	1.00	19000	$	19,000	Vendor Quote
				SUBTOTAL	**$**	**218,110**	
O&M Contingencies	25%				$	54,528	10% Scope, 15% Bid
				SUBTOTAL	**$**	**54,530**	
				TOTAL YEARLY O&M COST	**$**	**272,640**	

PERIODIC COSTS							
Item	Unit		Unit Cost	Quantity		Cost	Source of Cost Data
5 Year Periodic Cost							
5-Year Review Not Required					$	-	
				SUBTOTAL	**$**	**-**	
Contingencies	25%				$	-	10% Scope, 15% Bid
				TOTAL 5 YEAR PERIODIC COST	**$**	**-**	
30 Year Periodic Cost							
Facility Reconstruction Not Required					$	-	
				SUBTOTAL	**$**	**-**	
Contingencies	25%				$	-	10% Scope, 15% Bid
				TOTAL 30 YEAR PERIODIC COST	**$**	**-**	

Notes
gpm = gallons per minute
ls = lump sum
kwh = kilowatt hour
lb/yr = pounds per year
gal = gallon

Present Value		**3%**
10 Years	$	3,621,400
20 Years	$	5,351,900
30 Years	$	6,639,600
50 Years	$	8,310,700
100 Years	$	9,910,800

TABLE F-2
Preliminary Cost Estimate
LNAPL
Groundwater Extraction and Disposal
KRY Site

CAPITAL COSTS						
Item	Unit	Unit Cost	Quantity		Cost	Source of Cost Data
Groundwater Extraction System: Kalispell Pole Treatment Site	well	$ 11,900.69	26	$	309,418	RACER
Free Product Removal: Kalispell Pole Treatment Site	ls	$ 102,698.00	1	$	102,698	RACER
Carbon Adsorption System: Kalispell Pole Treatment Site	gpm	$ 504.51	130	$	65,586	RACER
Groundwater Extraction System: Reliance Refinery Site	well	$ 11,992.80	20	$	239,856	RACER
Free Product Removal: Reliance Refinery Site	ls	$ 79,569.00	1	$	79,569	RACER
Carbon Adsorption System: Kalispell Pole Treatment Site	gpm	$ 429.99	100	$	42,999	RACER
Treated Water Combined Discharge Pipeline	ls	$ 43,788.00	1	$	43,788	RACER
Residual Waste Management	ls	$ 6,742.00	1	$	6,742	RACER
Overhead Electical Distribution System	ls	$ 34,874.00	1	$	34,874	RACER
			SUBTOTAL	**$**	**925,530**	
Construction Contingencies	25%			$	231,383	10% Scope, 15% Bid
			SUBTOTAL	**$**	**1,156,910**	
Project Management	6%			$	69,415	EPA Cost Guidance
Remedial Design including Pilot Testing	12%	plus $150,000.00		$	288,829	EPA Cost Guidance
Construction Management	8%			$	92,553	EPA Cost Guidance
			SUBTOTAL	**$**	**450,800**	
			TOTAL CAPITAL COSTS	**$**	**1,607,710**	

ANNUAL OPERATION AND MAINTENANCE (O&M) COSTS						
Item	Unit	Unit Cost	Quantity		Cost	Source of Cost Data
Site Maintenance	ls	$ 46,276.50	1	$	46,277	Engineer Estimate
Site Operation	ls	$ 189,977.00	1	$	189,977	RACER
Power Kalispell Pole Treatment Site	kwh	$ 0.08	121263	$	9,701	RACER
Carbon Replacement Kalispell Pole Treatment Site	lb/yr	$ 1.81	594	$	1,075	RACER
Power Reliance Refinery Site	kwh	$ 0.08	77105	$	6,168	RACER
Carbon Replacement Reliance Refinery Site	lb/yr	$ 1.81	457	$	827	RACER
LNAPL Disposal	gal	$ 1.00	19000	$	19,000	Vendor Quote
			SUBTOTAL	**$**	**273,030**	
O&M Contingencies	25%			$	68,258	10% Scope, 15% Bid
			SUBTOTAL	**$**	**68,260**	
			TOTAL YEARLY O&M COST	**$**	**341,290**	

PERIODIC COSTS						
Item	Unit	Unit Cost	Quantity		Cost	Source of Cost Data
5 Year Periodic Cost						
5-Year Review Not Required				$	-	
			SUBTOTAL	**$**	**-**	
Contingencies	25%			$	-	10% Scope, 15% Bid
			TOTAL 5 YEAR PERIODIC COST	**$**	**-**	
30 Year Periodic Cost						
Facility Reconstruction Not Required				$	-	
			SUBTOTAL	**$**	**-**	
Contingencies	25%			$	-	10% Scope, 15% Bid
			TOTAL 30 YEAR PERIODIC COST	**$**	**-**	

Notes
gpm = gallons per minute
ls = lump sum
kwh = kilowatt hour
lb/yr = pounds per year
gal = gallon

Present Value	**3%**
10 Years	$ 4,519,000
20 Years	$ 6,685,200
30 Years	$ 8,297,100
50 Years	$ 10,389,000
100 Years	$ 12,392,100

TABLE F-3
Preliminary Cost Estimate
Groundwater
Extraction, Ex-Situ Treatment and Disposal - 75 GPM
KRY Site

CAPITAL COSTS							
Item	Unit		Unit Cost	Quantity		Cost	Source of Cost Data
Groundwater Extraction System: Kalispell Pole Treatment Site							
Shallow Wells	well	$	16,759.27	11	$	184,352	RACER
Deep Wells	well	$	39,170.00	1	$	39,170	RACER
Ex-Situ Bioreactor: Kalispell Pole Treatment Site	gpm	$	3,956.70	300	$	1,187,010	RACER
Carbon Adsorption System: Kalispell Pole Treatment Site	gpm	$	429.99	300	$	128,997	RACER
Groundwater Extraction System, Deep Wells: Highway 2 Site	well	$	35,009.50	2	$	70,019	RACER
Ex-Situ Bioreactor: Highway 2 Site	gpm	$	4,484.91	80	$	358,793	RACER
Carbon Adsorption System: Highway 2 Oil Site	gpm	$	536.24	80	$	42,899	RACER
Treated Water Combined Discharge Pipeline	ls	$	72,722.00	1	$	72,722	RACER
Residual Waste Management	ls	$	4,050.00	1	$	4,050	RACER
Overhead Electical Distribution System	ls	$	34,874.00	1	$	34,874	RACER
				SUBTOTAL	**$**	**2,122,890**	
Construction Contingencies	25%				$	530,723	10% Scope, 15% Bid
				SUBTOTAL	**$**	**2,653,610**	
Project Management	5%				$	132,681	EPA Cost Guidance
Remedial Design including Pilot Testing	8% plus $100,000.00				$	312,289	EPA Cost Guidance
Construction Management	6%				$	159,217	EPA Cost Guidance
				SUBTOTAL	**$**	**604,190**	
				TOTAL CAPITAL COSTS	**$**	**3,257,800**	

ANNUAL OPERATION AND MAINTENANCE (O&M) COSTS							
Item	Unit		Unit Cost	Quantity		Cost	Source of Cost Data
Site Maintenance	ls	$	106,144.50	1	$	106,145	Engineer Estimate
Site Operation	ls	$	337,342.00	1	$	337,342	RACER
Power Kalispell Pole Treatment Site	kwh	$	0.08	271657	$	21,733	RACER
Natural Gas Kalispell Pole Treatment Site	mcf	$	6.87	41250	$	283,388	RACER
Carbon Replacement Kalispell Pole Treatment Site	lb/yr	$	1.81	1371	$	2,482	RACER
Power Highway 2 Site	kwh	$	0.08	90909	$	7,273	RACER
Natural Gas Highway 2 Site	mcf	$	6.87	11000	$	75,570	RACER
Carbon Replacement Highwya 2 Site	lb/yr	$	1.81	366	$	662	RACER
				SUBTOTAL	**$**	**834,590**	
O&M Contingencies	25%				$	208,648	10% Scope, 15% Bid
				SUBTOTAL	**$**	**208,650**	
				TOTAL YEARLY O&M COST	**$**	**1,043,240**	

PERIODIC COSTS							
Item	Unit		Unit Cost	Quantity		Cost	Source of Cost Data
5 Year Periodic Cost							
5-Year Review Not Required					$	-	
				SUBTOTAL	**$**	**-**	
Contingencies	25%				$	-	10% Scope, 15% Bid
				TOTAL 5 YEAR PERIODIC COST	**$**	**-**	
30 Year Periodic Cost							
Facility Reconstruction Not Required					$	-	
				SUBTOTAL	**$**	**-**	
Contingencies	25%				$	-	10% Scope, 15% Bid
				TOTAL 30 YEAR PERIODIC COST	**$**	**-**	

Notes
gpm = gallons per minute
ls = lump sum
kwh = kilowatt hour
mcr = thousand cubic feet
lb/yr = pounds per year
gal = gallon

Present Value		**3%**
10 Years	$	12,156,800
20 Years	$	18,778,600
30 Years	$	23,705,800
50 Years	$	30,100,100
100 Years	$	36,223,000

TABLE F-4
Preliminary Cost Estimate
Groundwater
In Situ Enhanced Bioremediation Using Proprietary Oxygen Release Compounds
KRY Site

Item	Unit	Unit Cost	Quantity	Cost	Source of Cost Data
CAPITAL COSTS					
Injection Points: 1.5 " Diameter, 22 Feet Deep	each	$ 300.00	1,300	$ 390,000	Vendor Quote
Regenesis' ORC Compound	lb	$ 6.50	55,158	$ 358,527	Vendor Quote
ORC Injection	each	$ 200.00	1,300	$ 260,000	Vendor Quote
			SUBTOTAL	**$ 1,008,530**	
Construction Contingencies	25%			$ 252,133	10% Scope, 15% Bid
			SUBTOTAL	**$ 1,260,660**	
Project Management	6%			$ 75,640	EPA Cost Guidance
Remedial Design including Pilot Testing	12% plus $100,000.00			$ 251,279	EPA Cost Guidance
Construction Management	8%			$ 100,853	EPA Cost Guidance
			SUBTOTAL	**$ 427,770**	
			TOTAL CAPITAL COSTS	**$ 1,688,430**	
ANNUAL OPERATION AND MAINTENANCE (O&M) COSTS					
Item	Unit	Unit Cost	Quantity	Cost	Source of Cost Data
Yearly ORC Injection	ls	$ 1,260,660.00	1	$ 1,260,660	Vendor Quote
Site Operation	ls	$ 20,000.00	1	$ 20,000	Engineer Estimate
			SUBTOTAL	**$ 1,280,660**	
O&M Contingencies	25%			$ 320,165	10% Scope, 15% Bid
			SUBTOTAL	**$ 320,170**	
			TOTAL YEARLY O&M COST	**$ 1,600,830**	
PERIODIC COSTS					
Item	Unit	Unit Cost	Quantity	Cost	Source of Cost Data
5 Year Periodic Cost					
5-Year Review Not Required				$ -	Engineering Estimate
			SUBTOTAL	**$ -**	
Contingencies	25%			$ -	10% Scope, 15% Bid
			TOTAL 5 YEAR PERIODIC COST	**$ -**	
30 Year Periodic Cost					
Facility Reconstruction Not Required				$ -	
			SUBTOTAL	**$ -**	
Contingencies	25%			$ -	10% Scope, 15% Bid
			TOTAL 30 YEAR PERIODIC COST	**$ -**	

Notes
lb + pound
ls = lump sum

Present Value	**3%**
10 Years	$ 15,343,800
20 Years	$ 25,504,700
30 Years	$ 33,065,400
50 Years	$ 42,877,400
100 Years	$ 52,272,900

TABLE F-5
Preliminary Cost Estimate
Groundwater
In Situ Chemical Oxidation
KRY Site

Item	Unit	Unit Cost	Quantity	Cost	Source of Cost Data
CAPITAL COSTS					
Kalispell Pole Treatment Site					
Injection Wells: 2" Diameter, 22 Feet Deep	each	$ 500.00	650	$ 325,000	Vendor Quote
Ozonation System: 60 lb/day	lb	$ 4,000.00	60	$ 240,000	Vendor Quote
Piping	ls	$ 200,000.00	1	$ 200,000	Engineer Estimate
Reliance Refinery Site					
Injection Wells: 2" Diameter, 22 Feet Deep	each	$ 500.00	300	$ 150,000	Vendor Quote
Ozonation System: 10 lb/day	lb	$ 15,000.00	10	$ 150,000	Vendor Quote
Piping	ls	$ 100,000.00	1	$ 100,000	Engineer Estimate
			SUBTOTAL	**$ 1,165,000**	
Construction Contingencies	25%			$ 291,250	10% Scope, 15% Bid
			SUBTOTAL	**$ 1,456,250**	
Project Management	6%			$ 87,375	EPA Cost Guidance
Remedial Design including Pilot Testing	12%	plus $100,000.00		$ 274,750	EPA Cost Guidance
Construction Management	8%			$ 116,500	EPA Cost Guidance
			SUBTOTAL	**$ 478,630**	
			TOTAL CAPITAL COSTS	**$ 1,934,880**	
ANNUAL OPERATION AND MAINTENANCE (O&M) COSTS					
Site Maintenance	ls	$ 58,250.00	1	$ 58,250	Vendor Quote
Site Operation	ls	$ 200,000.00	1	$ 200,000	Engineer Estimate
Power	kwh	$ 0.08	657000	$ 52,560	
			SUBTOTAL	**$ 310,810**	
O&M Contingencies	25%			$ 77,703	10% Scope, 15% Bid
			SUBTOTAL	**$ 77,700**	
			TOTAL YEARLY O&M COST	**$ 388,510**	
PERIODIC COSTS					
5 Year Periodic Cost					
5-Year Review Not Required				$ -	Engineering Estimate
			SUBTOTAL	**$ -**	
Contingencies	25%			$ -	10% Scope, 15% Bid
			TOTAL 5 YEAR PERIODIC COST	**$ -**	
30 Year Periodic Cost					
Facility Reconstruction Not Required				$ -	
			SUBTOTAL	**$ -**	
Contingencies	25%			$ -	10% Scope, 15% Bid
			TOTAL 30 YEAR PERIODIC COST	**$ -**	

Notes
lb = pound
ls = lump sum
kwh = kilowatt hour

Present Value	**3%**
10 Years	$ 5,248,900
20 Years	$ 7,714,900
30 Years	$ 9,549,800
50 Years	$ 11,931,200
100 Years	$ 14,211,400

TABLE F-6
Preliminary Cost Estimate
Soil
Surface Capping - 17.6 Acres
KRY Site

CAPITAL COSTS					
Item	Unit	Unit Cost	Quantity	Cost	Source of Cost Data
Pre-Grading	ac	$ 2,084.61	17.6	$ 36,689	RACER
Geomembrane	sy	$ 24.66	83,300	$ 2,053,785	RACER
Gravel Cushion	cy	$ 34.85	10,000	$ 348,522	RACER
Asphalt	sy	$ 6.43	83,300	$ 535,511	RACER
			SUBTOTAL	**$ 2,974,510**	
Construction Contingencies	25%			$ 743,628	10% Scope, 15% Bid
			SUBTOTAL	**$ 3,718,140**	
Project Management	5%			$ 185,907	EPA Cost Guidance
Remedial Design	8%			$ 297,451	EPA Cost Guidance
Construction Management	6%			$ 223,088	EPA Cost Guidance
			SUBTOTAL	**$ 706,450**	
			TOTAL CAPITAL COSTS	**$ 4,424,590**	
ANNUAL OPERATION AND MAINTENANCE (O&M) COSTS					
Item	Unit	Unit Cost	Quantity	Cost	Source of Cost Data
Site Maintenance	ls	$ 29,745.10	1	$ 29,745	Eng Estimate
			SUBTOTAL	**$ 29,750**	
O&M Contingencies	25%			$ 7,438	10% Scope, 15% Bid
			SUBTOTAL	**$ 7,440**	
			TOTAL YEARLY O&M COST	**$ 37,190**	
PERIODIC COSTS					
Item	Unit	Unit Cost	Quantity	Cost	Source of Cost Data
5 Year Periodic Cost					
5-Year Review Not Required				$ -	
			SUBTOTAL	**$ -**	
Contingencies	25%			$ -	10% Scope, 15% Bid
			TOTAL 5 YEAR PERIODIC COST	**$ -**	
30 Year Periodic Cost					
Facility Reconstruction Not Required				$ -	
			SUBTOTAL	**$ -**	
Contingencies	25%			$ -	10% Scope, 15% Bid
			TOTAL 30 YEAR PERIODIC COST	**$ -**	

Notes
ac = acres
sy = square yards
cy = cubic yards
ls = lump sum

Present Value	**3%**
10 Years	$ 4,741,800
20 Years	$ 4,977,900
30 Years	$ 5,153,500
50 Years	$ 5,381,500
100 Years	$ 5,599,800

TABLE F-7
Preliminary Cost Estimate
Soil
Excavation, Off-Site Disposal and Backfill
KRY Site

CAPITAL COSTS						
Item	Unit	Unit Cost	Quantity		Cost	Source of Cost Data
Excavation	cy	$ 3.89	272,200	$	1,058,550	RACER
Petroleum Contamination Soil Disposal	cy	$ 133.15	73,000	$	9,719,854	RACER
Dioxin Contaminated Soil Disposal	cy	$ 985.21	69,000	$	67,979,584	RACER
Clean Soil Backfill	cy	$ 10.84	130,200	$	1,411,872	RACER
Imported Soil Backfill	cy	$ 15.93	142,000	$	2,261,505	RACER
			SUBTOTAL	**$**	**82,431,370**	
Construction Contingencies	25%			$	20,607,843	10% Scope, 15% Bid
			SUBTOTAL	**$**	**103,039,210**	
Project Management	5%			$	5,151,961	EPA Cost Guidance
Remedial Design	6%			$	6,182,353	EPA Cost Guidance
Construction Management	6%			$	6,182,353	EPA Cost Guidance
			SUBTOTAL	**$**	**17,516,670**	
			TOTAL CAPITAL COSTS	**$**	**120,555,880**	

ANNUAL OPERATION AND MAINTENANCE (O&M) COSTS						
Item	Unit	Unit Cost	Quantity		Cost	Source of Cost Data
Site Maintenance	ls	$ 10,000.00	1	$	10,000	Engineer Estimate
			SUBTOTAL	**$**	**10,000**	
O&M Contingencies	25%			$	2,500	10% Scope, 15% Bid
			SUBTOTAL	**$**	**2,500**	
			TOTAL YEARLY O&M COST	**$**	**12,500**	

PERIODIC COSTS						
Item	Unit	Unit Cost	Quantity		Cost	Source of Cost Data
5 Year Periodic Cost						
5-Year Review Not Required				$	-	Engineering Estimate
			SUBTOTAL	**$**	**-**	
Contingencies	25%			$	-	10% Scope, 15% Bid
			TOTAL 5 YEAR PERIODIC COST	**$**	**-**	
30 Year Periodic Cost						
Facility Reconstruction Not Required				$	-	
			SUBTOTAL	**$**	**-**	
Contingencies	25%			$	-	10% Scope, 15% Bid
			TOTAL 30 YEAR PERIODIC COST	**$**	**-**	

Notes
cy = cubic yards
ls = lump sum

Present Value		**3%**
10 Years	$	120,662,500
20 Years	$	120,741,800
30 Years	$	120,800,900
50 Years	$	120,877,500
100 Years	$	120,950,900

Folder Cost Summary Report

System:

RACER Version: 8.1.2
Database Location: S:\State\CECRA\Kalispell\KPT Racer.mdb

Folder:

Folder Name: KRY FS

System:

System ID: KRY
System Name: Final KRY FS
System Category: None

Location
State / Country: MONTANA
City: KALISPELL

Location Modifiers	Default	User
Material:	1.117	1.117
Labor:	0.934	0.934
Equipment:	1.013	1.013

Options
Database: System Costs
Cost Database Date: 2006
Report Option: Fiscal

Description: Cost Estimates for the Final KRY Feasibility Study

Note: This report shows first year costs.

Folder Cost Summary Report

Alternative:

Alternative ID: FP 01
Alternative Name: FP01 Multiphase Extraction and Disposal
Alternative Type: None

Technology Names
Pre-Study: ☐
Study: ☐
Design: ☐
Interim/Removal Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☑
Long-Term Monitoring: ☐
Site Close-out: ☐

Documentation
Description: Free product (LNAPL) will be extreacted using bioslurper wells and disposed of off site.
Support Team: NA
References: None

Estimator Information
Estimator Name: Gary Sturm
Estimator Title: Senior Civil Engineer
Agency/Org./Office: Tetra Tech EM Inc.
Business Address: 7 West 6th Avenue Suite 612
Helena, MT 59601
Telephone Number: 406.442.5484
Email Address: gary.sturm@ttemi.com
Estimate Prepared Date: 04/27/2007

Estimator Signature: ______________________ Date: __________

Reviewer Information
Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ Date: __________

Note: This report shows first year costs.

Folder Cost Summary Report

Technology:

Technology Type:	Remedial Action
Technology Name:	Multiphase Extraction and Disposal
Description:	Free produce (LNAPL) will be extracted using bioslurping wells and disposed of off site. Two separate system are proposed for the site. System one is centered on the Kalispell Pole facility. System two is centered on the Reliance Refinery facility.

Media/Waste Type

Primary:	Free Product
Secondary:	Groundwater

Contaminant

Primary:	Volatile Organic Compounds (VOCs)
Secondary:	None

Approach:	Ex Situ
Start Date:	June, 2008

Rate Groups

Labor:	System Labor Rate
Analysis:	System Analysis Rate

Technology Markups:	System Defaults

Technology Markups	Markup	% Prime	% Sub.
Bioslurping	Yes	100	0
Overhead Electrical Distribution	Yes	100	0
Residual Waste Management	Yes	100	0
Bioslurping	Yes	100	0
Carbon Adsorption (Liquid)	Yes	100	0
Trenching/Piping	Yes	100	0
Carbon Adsorption (Liquid)	Yes	100	0

Technologies:

Technology: Bioslurping (#1)

Assembly		Direct Cost	Marked Up Cost
19040414	Packaged Coalescing 200 GPM Oil/Water Separator	24,336	31,990
19070102	2" Black Steel Pipe, Welded T & C Schedule 40	4,922	6,713
33010101	Mobilize/DeMobilize Drilling Rig & Crew	1,849	2,653
33010421	Disposable Boot Covers (Tyvek)	1	2
33010423	Disposable Gloves (Latex)	0	0
33010429	Disposable Ear Plugs	0	0
33020303	Organic Vapor Analyzer Rental, per Day	1,409	1,814

Note: This report shows first year costs.

33021720	Testing, purgeable organics (624, 8260)	4,040	5,201
33022131	Testing, purgeable halocarbons (SW5030/8010)	3,534	4,549
33022132	Testing, purgeable aromatics (SW5030/8020)	2,807	3,614
33111305	15 hp Liquid Ring Vacuum Pump	20,685	26,630
33111306	Seal Water Tank for Liquid Ring Pump	544	727
33132304	Stripping, in-situ vapor extraction of soil, extra	6,456	8,450
33132343	DOT steel drums, 55 gal., open, 17C	92	118
33170808	Decontaminate Rig, Augers, Screen (Rental Equipmen	4,143	6,455
33220112	Field Technician	53	160
33230102	4" PVC, Schedule 40, Well Casing	5,782	7,854
33230202	4" PVC, Schedule 40, Well Screen	13,969	18,874
33230302	4" PVC, Well Plug	1,207	1,600
33231101	Hollow Stem Auger, 8" Dia Borehole, Depth <= 100 f	21,521	29,557
33231172	Split Spoon Sample, 2" x 24", During Drilling	8,320	10,710
33231178	Move Rig/Equipment Around Site	8,200	11,533
33231182	DOT steel drums, 55 gal., open, 17C	3,940	5,072
33231186	Well Development Equipment Rental (weekly)	5,788	7,589
33231402	4" Screen, Filter Pack	11,909	16,059
33231502	Surface Pad, Concrete, 4' x 4' x 4"	2,197	2,968
33231812	4" Well, Portland Cement Grout	475	611
33232102	4" Well, Bentonite Seal	2,701	3,655
33260102	Pipe, steel, black, threaded, 2" diameter, schedul	12,598	18,796
33260460	4" PVC, Schedule 80, Manifold Piping	34,361	50,930
33270126	4" PVC, Schedule 80, Tee	1,095	1,409
33270136	4" PVC, Schedule 80, 90 Degree, Elbow	782	1,006
33270441	4" PVC, Sch 80, Ball Valve	7,726	9,946
33270502	Tee, steel, malleable iron, black, straight, threa	2,286	3,473
33270512	Elbow, 90 Deg., steel, malleable iron, black, stra	1,433	2,168
33290120	35 GPM, 1 HP, Transfer Pump with Motor, Valves, Pi	2,790	3,770
33310209	Pressure Gauge	2,946	4,123
	Total Bioslurping (#1)	226,896	310,780

Technology: Overhead Electrical Distribution (#1)

Assembly		Direct Cost	Marked Up Cost
20020301	1/0 ACSR Conductor	4,277	6,388
20020310	1/C #2 Aluminum, Bare, Wire	1,528	2,299
20020403	40' Class 3 Treated Power Pole	4,881	6,884
20020421	Straight-line Structure, 15 KV Pole Top	2,608	3,859
20020431	Terminal Structure, 15 KV Pole Top	5,441	7,764
20020521	15 KV, 3/0, Shielded Cable, Copper	607	846
20020546	Cable splice, grounded, shielded, 15 kV, #2-4/0	3,837	5,779
20039902	4" Rigid Steel Conduit	747	1,056
	Total Overhead Electrical Distribution (#1)	23,926	34,874

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Residual Waste Management (#1)

Assembly		Direct Cost	Marked Up Cost
33190103	Secondary containment and storage, storage systems	360	542
33190204	Subcontracted shipping of hazardous waste, transpo	4,426	4,426
33190317	Commercial RCRA landfills, additional landfill dis	498	641
33197205	Commercial RCRA landfills, drummed waste disposal,	2,520	2,520
	Total Residual Waste Management (#1)	7,804	8,128

Technology: Bioslurping (#2)

Assembly		Direct Cost	Marked Up Cost
33010101	Mobilize/DeMobilize Drilling Rig & Crew	1,849	2,653
33010421	Disposable Boot Covers (Tyvek)	1	2
33010423	Disposable Gloves (Latex)	0	0
33010429	Disposable Ear Plugs	0	0
33020303	Organic Vapor Analyzer Rental, per Day	1,025	1,319
33021720	Testing, purgeable organics (624, 8260)	3,108	4,001
33022131	Testing, purgeable halocarbons (SW5030/8010)	2,718	3,499
33022132	Testing, purgeable aromatics (SW5030/8020)	2,160	2,780
33111305	15 hp Liquid Ring Vacuum Pump	20,685	26,630
33111306	Seal Water Tank for Liquid Ring Pump	544	727
33132343	DOT steel drums, 55 gal., open, 17C	92	118
33132361	1000 SCFM, Vapor Recovery System	28,050	36,111
33170808	Decontaminate Rig, Augers, Screen (Rental Equipmen	3,013	4,695
33220112	Field Technician	26	80
33230102	4" PVC, Schedule 40, Well Casing	4,447	6,042
33230202	4" PVC, Schedule 40, Well Screen	10,746	14,519
33230302	4" PVC, Well Plug	928	1,231
33231101	Hollow Stem Auger, 8" Dia Borehole, Depth <= 100 f	16,555	22,736
33231172	Split Spoon Sample, 2" x 24", During Drilling	6,400	8,239
33231178	Move Rig/Equipment Around Site	6,232	8,765
33231182	DOT steel drums, 55 gal., open, 17C	3,023	3,892
33231186	Well Development Equipment Rental (weekly)	4,210	5,519
33231402	4" Screen, Filter Pack	9,161	12,353
33231502	Surface Pad, Concrete, 4' x 4' x 4"	1,690	2,283
33231812	4" Well, Portland Cement Grout	365	470
33232102	4" Well, Bentonite Seal	2,078	2,812
33260413	2" PVC, Schedule 40, Connection Piping	3,503	5,307
33260460	4" PVC, Schedule 80, Manifold Piping	26,432	39,177
33270104	2" PVC, Schedule 40, Tee	42	54
33270114	2" PVC, Schedule 40, 90 Degree, Elbow	34	44
33270126	4" PVC, Schedule 80, Tee	842	1,084
33270136	4" PVC, Schedule 80, 90 Degree, Elbow	601	774
33270441	4" PVC, Sch 80, Ball Valve	5,943	7,651

Note: This report shows first year costs.

Folder Cost Summary Report

33290120	35 GPM, 1 HP, Transfer Pump with Motor, Valves, Pi	2,790	3,770
33310209	Pressure Gauge	2,266	3,172
	Total Bioslurping (#2)	171,560	232,507

Technology: Carbon Adsorption (Liquid) (#1)

Assembly		Direct Cost	Marked Up Cost
18020322	8" Structural Slab on Grade	539	757
33132025	Aqueous organic & highly toxic wastes, carbon adso	40,720	53,172
33290124	150 GPM, 5 HP, Transfer Pump with Motor, Valves, P	8,503	11,656
	Total Carbon Adsorption (Liquid) (#1)	49,762	65,586

Technology: Trenching/Piping (#1)

Assembly		Direct Cost	Marked Up Cost
17030257	Excavating, trench, medium soil, 4' to 6' deep, 1	779	1,152
17030415	Backfill with Excavated Material	6,902	10,584
17030449	Horizontal Boring Under Road, 10" Diameter 6' x 3'	5,849	8,292
18020301	Asphalt Pavement - 10" Subgrade, 9" Base, 1 1/2" T	4,160	5,539
33260415	4" PVC, Schedule 40, Connection Piping	12,153	18,220
	Total Trenching/Piping (#1)	29,842	43,788

Technology: Carbon Adsorption (Liquid) (#2)

Assembly		Direct Cost	Marked Up Cost
18020322	8" Structural Slab on Grade	432	606
33132022	Aqueous organic & highly toxic wastes, carbon adso	27,723	36,065
33290123	100 GPM, 5 HP, Transfer Pump with Motor, Valves, P	4,646	6,328
	Total Carbon Adsorption (Liquid) (#2)	32,801	42,999
	Total Technology:	542,592	738,662

Note: This report shows first year costs.

Folder Cost Summary Report

Technology:

Technology Type:	Operations & Maintenance
Technology Name:	Operation and Maintenance
Description:	O & M for a mult-phase extraction system for 10 years.
Media/Waste Type	
Primary:	Free Product
Secondary:	Groundwater
Contaminant	
Primary:	Semi-Volatile Organic Compounds (SVOCs)
Secondary:	Volatile Organic Compounds (VOCs)
Start Date:	June, 2008
Rate Groups	
Labor:	System Labor Rate
Analysis:	System Analysis Rate
Technology Markups:	System Defaults

Technology Markups	Markup	% Prime	% Sub.
Operations and Maintenance	Yes	100	0

Technologies:

Technology: Operations and Maintenance (#1)

Assembly		Direct Cost	Marked Up Cost
33010423	Disposable Gloves (Latex)	105	135
33010425	Disposable Coveralls (Tyvek)	2,359	3,037
33190340	Non Haz Drummed Site Waste - Load, Transp, & Landf	2,798	3,602
33199921	DOT steel drums, 55 gal., open, 17C	1,099	1,415
33220104	Senior Staff Engineer	1,939	5,855
33240104	Startup Costs	350,891	492,496
99020110	Annual Maintenance Materials and Labor	6,510	9,137
Bioslurping			
33021721	Testing, semi-volatile organics (625, 8270)	9,956	12,818

Note: This report shows first year costs.

Folder Cost Summary Report

33022135	Testing, base neutral & acid extractable organics	17,479	22,502
33220106	Staff Engineer	4,125	12,453
33220112	Field Technician	14,984	45,237
33420101	Electrical Charge	26,946	34,689
Carbon Adsorption (Liquid)			
33022135	Testing, base neutral & acid extractable organics	5,826	7,501
33132052	Aqueous organic & highly toxic wastes, carbon adso	657	846
33132065	Removal, Transport, Regeneration of Spent Carbon,	418	539
33220106	Staff Engineer	1,701	5,134
33220112	Field Technician	6,184	18,669
33420101	Electrical Charge	1,332	1,715
Carbon Adsorption (Liquid)			
33022135	Testing, base neutral & acid extractable organics	5,826	7,501
33132052	Aqueous organic & highly toxic wastes, carbon adso	505	651
33132065	Removal, Transport, Regeneration of Spent Carbon,	322	414
33220106	Staff Engineer	1,556	4,697
33220112	Field Technician	5,576	16,834
33420101	Electrical Charge	1,025	1,319
Bioslurping			
33021721	Testing, semi-volatile organics (625, 8270)	6,638	8,545
33022135	Testing, base neutral & acid extractable organics	11,653	15,001
33220106	Staff Engineer	3,872	11,688
33220112	Field Technician	14,112	42,604
33420101	Electrical Charge	22,047	28,382
	Total Operations and Maintenance (#1)	528,441	815,413
	Total Technology:	528,441	815,413
	Total Alternative:	**1,071,032**	**1,554,075**

Note: This report shows first year costs.

Folder Cost Summary Report

Alternative:

Alternative ID: FP 02
Alternative Name: FP02 Groundwater Extraction and Disposal
Alternative Type: None

Technology Names

- Pre-Study: ☐
- Study: ☐
- Design: ☐
- Interim/Removal Action: ☐
- Remedial Action: ☑
- Operations & Maintenance: ☑
- Long-Term Monitoring: ☐
- Site Close-out: ☐

Documentation

Description: Free product (LNAPL) will be extracted using extraction wells and skimmers and disposed of off site.
Support Team: NA
References: None

Estimator Information

Estimator Name: Gary Sturm
Estimator Title: Senior Civil Engineer
Agency/Org./Office: Tetra Tech EM Inc.
Business Address: 7 West 6th Avenue Suite 612
Helena, MT 59601
Telephone Number: 406.442.5484
Email Address: gary.sturm@ttemi.com
Estimate Prepared Date: 04/27/2007

Estimator Signature: ____________________ Date: __________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ____________________ Date: __________

Note: This report shows first year costs.

Folder Cost Summary Report

Technology:

Technology Type:	Remedial Action
Technology Name:	Extaction Wells and Disposal
Description:	Free product (LNAPL) will be extracted using wells and skimmers and disposed of off site. Two separate systems will be constructed. System one will serve the Kalispell Post facility area. System two will serve the Reliance Refinery area.

Media/Waste Type

Primary:	Free Product
Secondary:	Groundwater

Contaminant

Primary:	Volatile Organic Compounds (VOCs)
Secondary:	None

Approach:	In Situ
Start Date:	June, 2008

Rate Groups

Labor:	System Labor Rate
Analysis:	System Analysis Rate

Technology Markups:	System Defaults

Technology Markups	Markup	% Prime	% Sub.
Free Product Removal	Yes	100	0
Overhead Electrical Distribution	Yes	100	0
Residual Waste Management	Yes	100	0
Groundwater Extraction Wells	Yes	100	0
Free Product Removal	Yes	100	0
Groundwater Extraction Wells	Yes	100	0
Trenching/Piping	Yes	100	0
Carbon Adsorption (Liquid)	Yes	100	0
Carbon Adsorption (Liquid)	Yes	100	0

Technologies:

Technology: Free Product Removal (#1)

Assembly		Direct Cost	Marked Up Cost
33109656	Storage Tanks, steel, above ground, single wall, 5	1,560	2,092
33230820	Product Recovery Pump, Shallow Depths (<=20 ft), C	33,298	42,866
33230822	Product Recovery Pump, 2" Oil Skimmer, Controls, E	39,958	51,439
33260101	Pipe, steel, black, threaded, 1" diameter, schedul	4,209	6,300

Note: This report shows first year costs.

Folder Cost Summary Report

		Direct Cost	Marked Up Cost
	Total Free Product Removal (#1)	79,024	102,698

Technology: Overhead Electrical Distribution (#1)

Assembly		Direct Cost	Marked Up Cost
20020301	1/0 ACSR Conductor	4,277	6,388
20020310	1/C #2 Aluminum, Bare, Wire	1,528	2,299
20020403	40' Class 3 Treated Power Pole	4,881	6,884
20020421	Straight-line Structure, 15 KV Pole Top	2,608	3,859
20020431	Terminal Structure, 15 KV Pole Top	5,441	7,764
20020521	15 KV, 3/0, Shielded Cable, Copper	607	846
20020546	Cable splice, grounded, shielded, 15 kV, #2-4/0	3,837	5,779
20039902	4" Rigid Steel Conduit	747	1,056
	Total Overhead Electrical Distribution (#1)	23,926	34,874

Technology: Residual Waste Management (#1)

Assembly		Direct Cost	Marked Up Cost
33190103	Secondary containment and storage, storage systems	360	542
33190204	Subcontracted shipping of hazardous waste, transpo	4,426	4,426
33190317	Commercial RCRA landfills, additional landfill dis	498	641
33197205	Commercial RCRA landfills, drummed waste disposal,	1,134	1,134
	Total Residual Waste Management (#1)	6,418	6,742

Technology: Groundwater Extraction Wells (#1)

Assembly		Direct Cost	Marked Up Cost
33010101	Mobilize/DeMobilize Drilling Rig & Crew	1,849	2,653
33020303	Organic Vapor Analyzer Rental, per Day	7,428	9,562
33109660	Storage Tanks, steel, above ground, single wall, 5	5,255	6,912
33170808	Decontaminate Rig, Augers, Screen (Rental Equipmen	16,949	26,408
33220112	Field Technician	4,149	12,526
33230103	6" PVC, Schedule 40, Well Casing	7,010	9,480
33230157	2" Pitless Adapter	5,939	7,651
33230203	6" PVC, Schedule 40, Well Screen	11,879	16,001
33230303	6" PVC, Well Plug	2,669	3,516
33230521	4" Submersible Pump, 0.3-7 GPM, Head <=140', 1/3 h	54,642	70,343
33231103	Hollow Stem Auger, 11" Dia Borehole, Depth <= 100	30,475	41,853
33231172	Split Spoon Sample, 2" x 24", During Drilling	3,474	4,472
33231182	DOT steel drums, 55 gal., open, 17C	11,360	14,625
33231186	Well Development Equipment Rental (weekly)	13,682	17,937
33231403	6" Screen, Filter Pack	10,511	14,174
33231813	6" Well, Portland Cement Grout	114	146
33232103	6" Well, Bentonite Seal	4,321	5,847

Note: This report shows first year costs.

Folder Cost Summary Report

33232206	Restricted Area, Well Protection (with 4 Posts & E	28,691	40,502
33260425	1" PVC, Schedule 80, Connection Piping	3,155	4,811
	Total Groundwater Extraction Wells (#1)	223,552	309,418

Technology: Free Product Removal (#2)

Assembly		Direct Cost	Marked Up Cost
33109656	Storage Tanks, steel, above ground, single wall, 5	1,560	2,092
33230820	Product Recovery Pump, Shallow Depths (<=20 ft), C	25,614	32,974
33230822	Product Recovery Pump, 2" Oil Skimmer, Controls, E	30,737	39,569
33260101	Pipe, steel, black, threaded, 1" diameter, schedul	3,296	4,934
	Total Free Product Removal (#2)	61,207	79,569

Technology: Groundwater Extraction Wells (#2)

Assembly		Direct Cost	Marked Up Cost
33010101	Mobilize/DeMobilize Drilling Rig & Crew	1,849	2,653
33020303	Organic Vapor Analyzer Rental, per Day	5,635	7,254
33109660	Storage Tanks, steel, above ground, single wall, 5	5,255	6,912
33170808	Decontaminate Rig, Augers, Screen (Rental Equipmen	12,806	19,953
33220112	Field Technician	3,198	9,654
33230103	6" PVC, Schedule 40, Well Casing	5,392	7,292
33230157	2" Pitless Adapter	4,568	5,885
33230203	6" PVC, Schedule 40, Well Screen	9,137	12,308
33230303	6" PVC, Well Plug	2,053	2,704
33230521	4" Submersible Pump, 0.3-7 GPM, Head <=140', 1/3 h	42,032	54,110
33231103	Hollow Stem Auger, 11" Dia Borehole, Depth <= 100	23,442	32,195
33231172	Split Spoon Sample, 2" x 24", During Drilling	2,651	3,413
33231182	DOT steel drums, 55 gal., open, 17C	8,795	11,322
33231186	Well Development Equipment Rental (weekly)	10,524	13,798
33231403	6" Screen, Filter Pack	8,086	10,903
33231813	6" Well, Portland Cement Grout	114	146
33232103	6" Well, Bentonite Seal	3,324	4,498
33232206	Restricted Area, Well Protection (with 4 Posts & E	22,070	31,155
33260425	1" PVC, Schedule 80, Connection Piping	2,427	3,700
	Total Groundwater Extraction Wells (#2)	173,360	239,856

Technology: Trenching/Piping (#1)

Assembly		Direct Cost	Marked Up Cost
17030257	Excavating, trench, medium soil, 4' to 6' deep, 1	779	1,152
17030415	Backfill with Excavated Material	6,902	10,584
17030449	Horizontal Boring Under Road, 10" Diameter 6' x 3'	5,849	8,292
18020301	Asphalt Pavement - 10" Subgrade, 9" Base, 1 1/2" T	4,160	5,539

Note: This report shows first year costs.

		Direct Cost	Marked Up Cost
33260415	4" PVC, Schedule 40, Connection Piping	12,153	18,220
	Total Trenching/Piping (#1)	29,842	43,788

Technology: Carbon Adsorption (Liquid) (#1)

Assembly		Direct Cost	Marked Up Cost
18020322	8" Structural Slab on Grade	539	757
33132025	Aqueous organic & highly toxic wastes, carbon adso	40,720	53,172
33290124	150 GPM, 5 HP, Transfer Pump with Motor, Valves, P	8,503	11,656
	Total Carbon Adsorption (Liquid) (#1)	49,762	65,586

Technology: Carbon Adsorption (Liquid) (#2)

Assembly		Direct Cost	Marked Up Cost
18020322	8" Structural Slab on Grade	432	606
33132022	Aqueous organic & highly toxic wastes, carbon adso	27,723	36,065
33290123	100 GPM, 5 HP, Transfer Pump with Motor, Valves, P	4,646	6,328
	Total Carbon Adsorption (Liquid) (#2)	32,801	42,999
	Total Technology:	679,892	925,529

Folder Cost Summary Report

Technology:

Technology Type:	Operations & Maintenance
Technology Name:	Operation and Maintenance
Description:	O&M for an extraction well/skimmers system for ten years .

Media/Waste Type

Primary:	Groundwater
Secondary:	Free Product

Contaminant

Primary:	Volatile Organic Compounds (VOCs)
Secondary:	Semi-Volatile Organic Compounds (SVOCs)

Start Date:	June, 2008

Rate Groups

Labor:	System Labor Rate
Analysis:	System Analysis Rate
Technology Markups:	System Defaults

Technology Markups	Markup	% Prime	% Sub.
Operations and Maintenance	Yes	100	0

Technologies:

Technology: Operations and Maintenance (#1)

Assembly		Direct Cost	Marked Up Cost
33010423	Disposable Gloves (Latex)	156	201
33010425	Disposable Coveralls (Tyvek)	3,516	4,526
33190340	Non Haz Drummed Site Waste - Load, Transp, & Landf	4,197	5,403
33199921	DOT steel drums, 55 gal., open, 17C	1,649	2,123
33220104	Senior Staff Engineer	2,848	8,599
33240104	Startup Costs	65,111	92,277
99020110	Annual Maintenance Materials and Labor	8,071	11,438

Free Product Removal

Note: This report shows first year costs.

Folder Cost Summary Report

33022131	Testing, purgeable halocarbons (SW5030/8010)	8,562	11,022
33022132	Testing, purgeable aromatics (SW5030/8020)	6,803	8,758
33190341	Free Product Disposal	34,571	44,505
33220106	Staff Engineer	4,921	14,856
33220112	Field Technician	17,970	54,252
33420101	Electrical Charge	6,571	8,459
Groundwater Extraction Wells			
33022131	Testing, purgeable halocarbons (SW5030/8010)	4,349	5,599
33022132	Testing, purgeable aromatics (SW5030/8020)	3,455	4,448
33220106	Staff Engineer	2,352	7,100
33220112	Field Technician	8,562	25,850
33420101	Electrical Charge	1,192	1,534
Groundwater Extraction Wells			
33022131	Testing, purgeable halocarbons (SW5030/8010)	3,262	4,199
33022132	Testing, purgeable aromatics (SW5030/8020)	2,592	3,336
33220106	Staff Engineer	2,062	6,226
33220112	Field Technician	7,532	22,738
33420101	Electrical Charge	917	1,180
Free Product Removal			
33022131	Testing, purgeable halocarbons (SW5030/8010)	6,523	8,398
33022132	Testing, purgeable aromatics (SW5030/8020)	5,183	6,672
33190341	Free Product Disposal	26,248	33,791
33220106	Staff Engineer	4,161	12,562
33220112	Field Technician	15,195	45,875
33420101	Electrical Charge	3,838	4,940
Carbon Adsorption (Liquid)			
33022131	Testing, purgeable halocarbons (SW5030/8010)	1,631	2,099
33022132	Testing, purgeable aromatics (SW5030/8020)	1,296	1,668
33132052	Aqueous organic & highly toxic wastes, carbon adso	657	846
33132065	Removal, Transport, Regeneration of Spent Carbon,	418	539
33220106	Staff Engineer	1,701	5,134
33220112	Field Technician	6,184	18,669
33420101	Electrical Charge	1,332	1,715
Carbon Adsorption (Liquid)			
33022131	Testing, purgeable halocarbons (SW5030/8010)	1,631	2,099
33022132	Testing, purgeable aromatics (SW5030/8020)	1,296	1,668
33132052	Aqueous organic & highly toxic wastes, carbon adso	505	651
33132066	Removal, Transport, Regeneration of Spent Carbon,	146	188
33220106	Staff Engineer	1,556	4,697
33220112	Field Technician	5,576	16,834
33420101	Electrical Charge	1,025	1,319
	Total Operations and Maintenance (#1)	287,322	518,996
	Total Technology:	287,322	518,996
	Total Alternative:	**967,214**	**1,444,526**

Note: This report shows first year costs.

Folder Cost Summary Report

Alternative:

Alternative ID: GW 02
Alternative Name: GW02 Extraction, Ex-Situ Treatment & Discharge
Alternative Type: None

Technology Names

- Pre-Study: ☐
- Study: ☐
- Design: ☐
- Interim/Removal Action: ☐
- Remedial Action: ☑
- Operations & Maintenance: ☑
- Long-Term Monitoring: ☐
- Site Close-out: ☐

Documentation

Description: Extract and treat groundwater using a bioreactor with discharge to surface water.
Support Team: NA
References: None

Estimator Information

Estimator Name: Gary Sturm
Estimator Title: Senior Civil Engineer
Agency/Org./Office: Tetra Tech EM Inc.
Business Address: 7 West 6th Avenue Suite 612
Helena, MT 59601
Telephone Number: 406.442.5484
Email Address: gary.sturm@ttemi.com
Estimate Prepared Date: 04/27/2007

Estimator Signature: ______________________ Date: ____________

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: ______________________ Date: ____________

Note: This report shows first year costs.

Folder Cost Summary Report

Technology:

Technology Type: Remedial Action
Technology Name: Extraction, Ex-Situ Treatment & Discharge
Description: Groundwater at the Kalispell Pole Treatment site will be extracted by 11 shallow wells and one deep well and treated in 3 ex-situ bioreactors and polished using carbon adsorption with surface discharge. Groundwater at the Yale Oil Treatment site will be extracted by 2 deep wells and treated in an ex-situ bioreactors and polished using carbon adsorption with surface discharge.

Media/Waste Type
Primary: Groundwater
Secondary: N/A

Contaminant
Primary: Volatile Organic Compounds (VOCs)
Secondary: None

Approach: Ex Situ
Start Date: June, 2008

Rate Groups
Labor: System Labor Rate
Analysis: System Analysis Rate

Technology Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Groundwater Extraction Wells	Yes	100	0
Ex Situ Bioreactors	Yes	100	0
Overhead Electrical Distribution	Yes	100	0
Trenching/Piping	Yes	100	0
Residual Waste Management	Yes	100	0
Carbon Adsorption (Liquid)	Yes	100	0
Groundwater Extraction Wells	Yes	100	0
Ex Situ Bioreactors	Yes	100	0
Carbon Adsorption (Liquid)	Yes	100	0
Groundwater Extraction Wells	Yes	100	0

Technologies:

Technology: Groundwater Extraction Wells (#1)

Assembly		Direct Cost	Marked Up Cost
33010101	Mobilize/DeMobilize Drilling Rig & Crew	1,849	2,653
33020303	Organic Vapor Analyzer Rental, per Day	3,202	4,122
33109666	Storage Tanks, steel, above ground, single wall, 3	27,992	36,464

Note: This report shows first year costs.

33170808	Decontaminate Rig, Augers, Screen (Rental Equipmen	7,156	11,150
33220112	Field Technician	1,771	5,345
33230103	6" PVC, Schedule 40, Well Casing	2,966	4,011
33230157	2" Pitless Adapter	2,513	3,237
33230203	6" PVC, Schedule 40, Well Screen	5,026	6,770
33230303	6" PVC, Well Plug	1,129	1,487
33230541	4" Submersible Pump, 21-32 GPM, 61'< Head <=120',	22,794	29,344
33231103	Hollow Stem Auger, 11" Dia Borehole, Depth <= 100	12,893	17,707
33231172	Split Spoon Sample, 2" x 24", During Drilling	1,463	1,883
33231182	DOT steel drums, 55 gal., open, 17C	5,039	6,487
33231186	Well Development Equipment Rental (weekly)	5,788	7,589
33231403	6" Screen, Filter Pack	4,447	5,997
33231813	6" Well, Portland Cement Grout	114	146
33232103	6" Well, Bentonite Seal	1,828	2,474
33232206	Restricted Area, Well Protection (with 4 Posts & E	12,139	17,135
33260425	1" PVC, Schedule 80, Connection Piping	13,350	20,353
	Total Groundwater Extraction Wells (#1)	133,458	184,352

Technology: Ex Situ Bioreactors (#1)

Assembly		Direct Cost	Marked Up Cost
18020322	8" Structural Slab on Grade	3,007	4,221
33119310	Boiler, packaged water tube, gas fired, steam or h	17,859	24,167
33119320	Heat Exchanger, shell & tube type, cast iron heads	9,148	11,950
33119328	Fixed growth systems, fixed film biological reacto	244,070	314,204
33119332	Expansion Tank, Pipe, & Fittings, 1,440 - 2,400 MB	21,171	29,980
33260623	(2 1/2", 4") PVC Double-wall Piping, with Fittings	4,678	6,672
33290108	Pump, general utility, centrifugal, end suction, h	3,343	4,476
	Total Ex Situ Bioreactors (#1)	303,275	395,670

Technology: Overhead Electrical Distribution (#1)

Assembly		Direct Cost	Marked Up Cost
20020301	1/0 ACSR Conductor	4,277	6,388
20020310	1/C #2 Aluminum, Bare, Wire	1,528	2,299
20020403	40' Class 3 Treated Power Pole	4,881	6,884
20020421	Straight-line Structure, 15 KV Pole Top	2,608	3,859
20020431	Terminal Structure, 15 KV Pole Top	5,441	7,764
20020521	15 KV, 3/0, Shielded Cable, Copper	607	846
20020546	Cable splice, grounded, shielded, 15 kV, #2-4/0	3,837	5,779
20039902	4" Rigid Steel Conduit	747	1,056
	Total Overhead Electrical Distribution (#1)	23,926	34,874

Note: This report shows first year costs.

Folder Cost Summary Report

Technology: Trenching/Piping (#1)

Assembly		Direct Cost	Marked Up Cost
17030257	Excavating, trench, medium soil, 4' to 6' deep, 1	1,039	1,536
17030415	Backfill with Excavated Material	9,203	14,112
17030418	Delivered & Dumped, Backfill with Stone	3,234	4,183
17030449	Horizontal Boring Under Road, 10" Diameter 6' x 3'	5,849	8,292
17030513	Compaction, subgrade, 18" wide, 8" lifts, walk beh	187	291
33260417	8" PVC, Schedule 40, Connection Piping	30,177	44,307
	Total Trenching/Piping (#1)	49,689	72,722

Technology: Residual Waste Management (#1)

Assembly		Direct Cost	Marked Up Cost
33190103	Secondary containment and storage, storage systems	257	387
33190204	Subcontracted shipping of hazardous waste, transpo	2,213	2,213
33190317	Commercial RCRA landfills, additional landfill dis	498	641
33197205	Commercial RCRA landfills, drummed waste disposal,	810	810
	Total Residual Waste Management (#1)	3,778	4,050

Technology: Carbon Adsorption (Liquid) (#1)

Assembly		Direct Cost	Marked Up Cost
18020322	8" Structural Slab on Grade	432	606
33132022	Aqueous organic & highly toxic wastes, carbon adso	27,723	36,065
33290123	100 GPM, 5 HP, Transfer Pump with Motor, Valves, P	4,646	6,328
	Total Carbon Adsorption (Liquid) (#1)	32,801	42,999

Technology: Groundwater Extraction Wells (#2)

Assembly		Direct Cost	Marked Up Cost
17020203	Demolish Bituminous Pavement with Air Equipment	24	37
33010101	Mobilize/DeMobilize Drilling Rig & Crew	1,849	2,653
33020303	Organic Vapor Analyzer Rental, per Day	640	824
33109660	Storage Tanks, steel, above ground, single wall, 5	5,255	6,912
33170808	Decontaminate Rig, Augers, Screen (Rental Equipmen	1,507	2,347
33220112	Field Technician	740	2,234
33230103	6" PVC, Schedule 40, Well Casing	3,595	4,861
33230157	2" Pitless Adapter	457	589
33230203	6" PVC, Schedule 40, Well Screen	1,305	1,758
33230303	6" PVC, Well Plug	205	270
33230550	4" Submersible Pump, 33-55 GPM, 161'< Head <=220',	7,237	9,317
33231152	Air Rotary, 10" Dia Borehole (Unconsolidated), 100	17,978	24,690

Note: This report shows first year costs.

33231172	Split Spoon Sample, 2" x 24", During Drilling	1,280	1,648
33231182	DOT steel drums, 55 gal., open, 17C	2,748	3,538
33231186	Well Development Equipment Rental (weekly)	1,052	1,380
33231403	6" Screen, Filter Pack	1,155	1,558
33231813	6" Well, Portland Cement Grout	993	1,278
33232103	6" Well, Bentonite Seal	332	450
33232206	Restricted Area, Well Protection (with 4 Posts & E	2,207	3,116
33260428	2" PVC, Schedule 80, Connection Piping	373	560
	Total Groundwater Extraction Wells (#2)	50,933	70,019

Technology: Ex Situ Bioreactors (#2)

Assembly		Direct Cost	Marked Up Cost
18020322	8" Structural Slab on Grade	2,377	3,337
33119309	Boiler, packaged water tube, gas fired, steam or h	15,980	21,619
33119319	Heat Exchanger, shell & tube type, cast iron heads	7,422	9,716
33119327	Fixed growth systems, fixed film biological reacto	219,826	282,993
33119332	Expansion Tank, Pipe, & Fittings, 1,440 - 2,400 MB	21,171	29,980
33260622	(2", 4") PVC Double-wall Piping, with Fittings	4,678	6,672
33290108	Pump, general utility, centrifugal, end suction, h	3,343	4,476
	Total Ex Situ Bioreactors (#2)	274,797	358,793

Technology: Carbon Adsorption (Liquid) (#2)

Assembly		Direct Cost	Marked Up Cost
18020322	8" Structural Slab on Grade	360	505
33132022	Aqueous organic & highly toxic wastes, carbon adso	27,723	36,065
33290123	100 GPM, 5 HP, Transfer Pump with Motor, Valves, P	4,646	6,328
	Total Carbon Adsorption (Liquid) (#2)	32,729	42,899

Technology: Groundwater Extraction Wells (#3)

Assembly		Direct Cost	Marked Up Cost
33010101	Mobilize/DeMobilize Drilling Rig & Crew	1,849	2,653
33020303	Organic Vapor Analyzer Rental, per Day	384	495
33109660	Storage Tanks, steel, above ground, single wall, 5	5,255	6,912
33170808	Decontaminate Rig, Augers, Screen (Rental Equipmen	753	1,174
33220112	Field Technician	370	1,117
33230103	6" PVC, Schedule 40, Well Casing	1,797	2,431
33230157	2" Pitless Adapter	228	294
33230203	6" PVC, Schedule 40, Well Screen	653	879
33230303	6" PVC, Well Plug	103	135
33230543	4" Submersible Pump, 21-32 GPM, 161'< Head <=200',	2,480	3,192
33231152	Air Rotary, 10" Dia Borehole (Unconsolidated), 100	8,989	12,345

Note: This report shows first year costs.

Folder Cost Summary Report

33231172	Split Spoon Sample, 2" x 24", During Drilling	640	824
33231182	DOT steel drums, 55 gal., open, 17C	1,557	2,005
33231186	Well Development Equipment Rental (weekly)	526	690
33231403	6" Screen, Filter Pack	578	779
33231813	6" Well, Portland Cement Grout	993	1,278
33232103	6" Well, Bentonite Seal	166	225
33232206	Restricted Area, Well Protection (with 4 Posts & E	1,104	1,558
33260425	1" PVC, Schedule 80, Connection Piping	121	185
	Total Groundwater Extraction Wells (#3)	28,546	39,170
	Total Technology:	933,932	1,245,549

Note: This report shows first year costs.

Folder Cost Summary Report

Technology:

Technology Type:	Operations & Maintenance
Technology Name:	Operation and Maintenance
Description:	O&M for groundwater extraction, treatment & discharge fot ten years.

Media/Waste Type

Primary:	Groundwater
Secondary:	N/A

Contaminant

Primary:	Volatile Organic Compounds (VOCs)
Secondary:	Semi-Volatile Organic Compounds (SVOCs)

Start Date:	June, 2008

Rate Groups

Labor:	System Labor Rate
Analysis:	System Analysis Rate
Technology Markups:	System Defaults

Technology Markups	Markup	% Prime	% Sub.
Operations and Maintenance	Yes	100	0

Technologies:

Technology: Operations and Maintenance (#1)

Assembly		Direct Cost	Marked Up Cost
33010423	Disposable Gloves (Latex)	164	211
33010425	Disposable Coveralls (Tyvek)	3,688	4,748
33190340	Non Haz Drummed Site Waste - Load, Transp, & Landf	4,430	5,704
33199921	DOT steel drums, 55 gal., open, 17C	1,741	2,241
33220104	Senior Staff Engineer	2,969	8,965
33240104	Startup Costs	118,418	166,207
99020110	Annual Maintenance Materials and Labor	14,679	20,602

Note: This report shows first year costs.

Folder Cost Summary Report

Groundwater Extraction Wells			
33022131	Testing, purgeable halocarbons (SW5030/8010)	8,562	11,022
33022132	Testing, purgeable aromatics (SW5030/8020)	6,803	8,758
33220106	Staff Engineer	1,592	4,806
33220112	Field Technician	5,814	17,552
33420101	Electrical Charge	2,750	3,540
Ex Situ Bioreactors			
33022131	Testing, purgeable halocarbons (SW5030/8010)	7,067	9,098
33022132	Testing, purgeable aromatics (SW5030/8020)	5,615	7,228
33119951	Biological treatment, bionutrients, 50 lb bag	7,599	9,783
33132916	Natural Gas Usage, per 1,000 CF	94,490	121,642
33220106	Staff Engineer	6,585	19,881
33220112	Field Technician	24,048	72,602
33330117	Hydrated Lime, Powdered, Bulk	8,819	11,353
33420101	Electrical Charge	4,850	6,244
Groundwater Extraction Wells			
33022131	Testing, purgeable halocarbons (SW5030/8010)	1,495	1,925
33022132	Testing, purgeable aromatics (SW5030/8020)	1,188	1,529
33220106	Staff Engineer	651	1,966
33220112	Field Technician	2,378	7,180
33420101	Electrical Charge	2,118	2,727
Ex Situ Bioreactors			
33022131	Testing, purgeable halocarbons (SW5030/8010)	7,067	9,098
33022132	Testing, purgeable aromatics (SW5030/8020)	5,615	7,228
33119951	Biological treatment, bionutrients, 50 lb bag	6,079	7,826
33132916	Natural Gas Usage, per 1,000 CF	75,592	97,314
33220106	Staff Engineer	5,789	17,478
33220112	Field Technician	21,036	63,507
33330117	Hydrated Lime, Powdered, Bulk	7,144	9,198
33420101	Electrical Charge	3,880	4,995
Carbon Adsorption (Liquid)			
33022131	Testing, purgeable halocarbons (SW5030/8010)	7,067	9,098
33022132	Testing, purgeable aromatics (SW5030/8020)	5,615	7,228
33132052	Aqueous organic & highly toxic wastes, carbon adso	505	651
33132065	Removal, Transport, Regeneration of Spent Carbon,	322	414
33220106	Staff Engineer	1,556	4,697
33220112	Field Technician	5,576	16,834
33420101	Electrical Charge	1,025	1,319
Carbon Adsorption (Liquid)			
33022131	Testing, purgeable halocarbons (SW5030/8010)	7,067	9,098
33022132	Testing, purgeable aromatics (SW5030/8020)	5,615	7,228
33132052	Aqueous organic & highly toxic wastes, carbon adso	405	521
33132065	Removal, Transport, Regeneration of Spent Carbon,	258	332
33220106	Staff Engineer	1,411	4,260
33220112	Field Technician	5,100	15,398
33420101	Electrical Charge	820	1,056

Note: This report shows first year costs.

Folder Cost Summary Report

Total Operations and Maintenance (#1)	513,058	822,291
Total Technology:	513,058	822,291
Total Alternative:	**1,446,991**	**2,067,841**
Total System:	3,485,237	5,066,441

Note: This report shows first year costs.

Folder Cost Summary Report

Total Folder:	3,485,237	5,066,441

Note: This report shows first year costs.

Table F-8
Preliminary Cost Estimate
Soil
Excavation, Ex Situ Treatment, Backfill
KRY Site

CAPITAL COSTS

Item	Unit	Unit Costs	Quantity	Cost	Source
Mobilization	%	8%	1	$100,975.26	Engineer's Estimate
Clear and Grub	acre	$186.00	6.5	$1,209.00	CostWorks 2006
Contaminated soil excavation and hauling	cy	$5.63	142,000	$799,460.00	CostWorks 2006
LTU Bottom slope dozer grading	cy	$1.90	3500	$6,650.00	CostWorks 2006
LTU Berm fill	cy	$0.77	9100	$7,007.00	CostWorks 2006
LTU Berm compaction	cy	$0.38	9100	$3,458.00	CostWorks 2006
4-inch PVC leachate piping	lf	$3.28	600	$1,968.00	CostWorks 2006
2-inch PVC irrigation piping	lf	$2.50	1000	$2,500.00	CostWorks 2006
Leachate Sump manhole	ea	$2,490.00	2	$4,980.00	CostWorks 2006
1 HP Submersible pump	ea	$1,000.00	2	$2,000.00	Engineer's Estimate
10,000-gallon double-walled fiberglass aboveground tank	ea	$46,000.00	2	$92,000.00	CostWorks 2006
8-inch structural slab on grade	sf	$7.20	500	$3,600.00	RACER
Haul road construction (base course on grade, includes material)	sy	$24.86	8300	$206,338.00	Engineer's Estimate
45 MIL RPP liner	sf	$0.61	215,250	$131,302.50	Engineer's Estimate
6 OZ Geocomposite drainage layer	sf	$0.40	215,520	$86,208.00	CostWorks 2006
Tilling contaminated soils in LTU (8 times per phase)	sy	$0.59	379,980	$224,188.20	Engineer's Estimate
Treated soil backfill (assumed to be same $ as clean soil backfill)	cy	$10.84	142,000	$1,539,280.00	RACER
Berm removal after treatment is completed	cy	$1.69	9100	$15,379.00	CostWorks 2006
Demolition of piping	lf	$7.50	600	$4,500.00	CostWorks 2006
Demolition of manhole	ea	$172.00	2	$344.00	CostWorks 2006
Haul road demolition	cy	$1.44	8300	$11,952.00	CostWorks 2006
			Subtotal	**$3,245,298.96**	
Construction Contingencies		25%		$811,324.74	10% Scope, 15% bid
			Subtotal	**$4,056,623.70**	
Project Management		6%		$243,397.42	EPA Cost Guidance
Remedial Design including Pilot Testing		12% plus $100,000		$586,794.84	EPA Cost Guidance
Construction Management		8%		$324,529.90	EPA Cost Guidance
			Subtotal	**$1,154,722.16**	
		TOTAL CAPITAL COSTS		**$5,211,345.86**	

ANNUAL OPERATIONS AND MAINTENANCE COSTS

Item	Unit	Unit Cost	Quantity	Cost	Source
Site Operation and Maintenance (technician)	wk	$450.00	50	$22,500.00	
Water	ls	$2.00	25,000	$50,000.00	
Miscellaneous (repairs, fertilizer, materials, etc.)	ls	$10,000.00	1	$10,000.00	
			Subtotal	**$82,500.00**	
O&M Contingencies		25%		**$20,625.00**	10% Scope, 15% Bid
		TOTAL YEARLY O&M COSTS		**$103,125.00**	

Present Value	**3%**
10 years	$ 6,091,024.00
20 years	$ 6,745,587.00
30 years	$ 7,232,645.00
50 years	$ 7,864,731.00
100 years	$ 8,469,985.00

Appendix B

Preferred Remedy Cost Summary Table
KRY Site

Technology	Capital Costs	Annual O&M	Total Net Present Value
Free-product recovery(GW)	$1,036,892.00	$331,412.10	$3,836,904.00
Chemical Oxidation	$3,269,188.49	$212,254.25	$5,079,759.00
Land Treatment Unit	$6,509,534.64	$103,125.00	$9,162,920.00
Lead Excavation, stabilization and disposal	$583,438.00	$0.00	$583,438.00
Sludge Disposal (Reliance)	$747,335.00	$0.00	$747,335.00
Free Product Excavation (Reliance)	$4,334,035.99	$0.00	$4,334,035.99
Common Elements	$28,125.00	$136,901.25	$3,338,416.00
Sawdust	$1,413,366.00	$0.00	$1,413,366.00
	$17,921,915.12	$783,692.60	$28,496,173.99

Table 1
Preferred Remedy Cost Estimate
Free-Product Recovery
Groundwater
KRY Site

CAPITAL COSTS

Item	Unit	Unit Costs	Quantity	Cost	Source
Groundwater Extraction System (KPT)	well	$11,900.69	26	$309,417.94	RACER
Free Product Recovery System (KPT)	ls	102,698.00	1	$102,698.00	RACER
Carbon Adsorption System (KPT)	gpm	$504.51	130	$65,586.30	RACER
Treated Water Combined Discharge Pipeline	ls	$43,788.00	1	$43,788.00	RACER
Residual Waste Management	ls	$6,742.00	1	$6,742.00	RACER
Overhead Electrical Distribution System	ls	$34,874.00	1	$34,874.00	RACER
			Subtotal	**$563,106.24**	
Construction Contingencies		25%		$140,776.56	10% Scope, 15% Bid
			Subtotal	**$703,882.80**	
Project Management		6%		$42,232.97	EPA Cost Guidance
Remedial Design including Pilot Testing		12% plus $150,000		$234,465.94	EPA Cost Guidance
Construction Management		8%		$56,310.62	EPA Cost Guidance
			Subtotal	**$333,009.53**	
		TOTAL CAPITAL COSTS		**$1,036,892.33**	

ANNUAL OPERATIONS AND MAINTENANCE COSTS

Item	Unit	Unit Cost	Quantity	Cost	Source	
Site Maintenance	ls	$46,276.50	1	$46,276.50	Engineer Estimate	
Site Operation	ls	$189,977.00	1	$189,977.00	RACER	
Power	kwh	$0.08	121263	$9,701.04	RACER	
Carbon Replacement	lb/yr	$1.81	594	$1,075.14	RACER	
LNAPL Disposal (KPT - listed waste)	gal	$2.00	9,050	$18,100.00	Invoice (with 5% inflation/year)	90,500 gallons recovered over 10 years
			Subtotal	**$265,129.68**		
O&M Contingencies		25%		**$66,282.42**	10% Scope, 15% Bid	
		TOTAL YEARLY O&M COSTS		**$331,412.10**		

Net present value calculations include capital costs and O&M costs for 10 years

Present Value	3%
10 years	$3,863,904

Table 2
Preferred Remedy Cost Estimate
Sawdust Excavation
KRY Site

CAPITAL COSTS

Item	Unit	Unit Cost	Quantity	Cost	Source
Mobilize equipment	ls	$10,000.00	1	$10,000.00	See Assumptions
Soil excavation and hauling	cy	$5.63	46,667	$262,735.21	RACER
Imported Soil Backfill	cy	$15.93	23,334	$371,710.62	RACER
Clean Soil Backfill	cy	$10.84	23,333	$252,929.72	RACER
			Subtotal	**$897,375.55**	
Construction Contingencies		25%		$224,343.89	
			Subtotal	**$1,121,719.44**	
Project Management		6%		$67,303.17	EPA Cost Guidance
Remedial Design		12%		$134,606.33	EPA Cost Guidance
Construction Management		8%		$89,737.56	EPA Cost Guidance
			Subtotal	**$291,647.05**	
		TOTAL CAPITAL COSTS		**$1,413,366.49**	

Assumptions:
- Mobilization cost is a blind estimate. Specific contractors and their locations were not determined for this estimate.
- Assumes that a 300 foot by 300 foot area that is 14 feet thick of sawdust needs to be excavated.
- Assumes that half of the excavated soil will be available for use as clean backfill, and that half of the volume will be imported fill

Notes:
Cost estimate based on 2007 economics; Assume 2-3% increase per year for inflation
cy = Cubic yard
ls = Lump Sum

Present Value	3%
1 year	$1,413,366.49

Table 3
Preferred Remedy Cost Estimate
Excavation, Ex Situ Treatment, and Backfill
KRY Site

CAPITAL COSTS

Item	Unit	Unit Costs	Quantity	Cost	Source
Mobilization	%	8%	1	$100,975.26	Engineer's Estimate
Clear and Grub	acre	$186.00	6.5	$1,209.00	CostWorks 2006
Contaminated soil excavation and hauling	cy	$5.63	178432	$1,004,572.16	CostWorks 2006
LTU Bottom slope dozer grading	cy	$1.90	3500	$6,650.00	CostWorks 2006
LTU Berm fill	cy	$0.77	9100	$7,007.00	CostWorks 2006
LTU Berm compaction	cy	$0.38	9100	$3,458.00	CostWorks 2006
4-inch PVC leachate piping	lf	$3.28	600	$1,968.00	CostWorks 2006
2-inch PVC irrigation piping	lf	$2.50	1000	$2,500.00	CostWorks 2006
Leachate Sump manhole	ea	$2,490.00	2	$4,980.00	CostWorks 2006
1 HP Submersible pump	ea	$1,000.00	2	$2,000.00	Engineer's Estimate
10,000-gallon double-walled fiberglass aboveground tank	ea	$46,000.00	2	$92,000.00	CostWorks 2006
8-inch structural slab on grade	sf	$7.20	500	$3,600.00	RACER
Haul road construction (base course on grade, includes material)	sy	$24.86	8300	$206,338.00	Engineer's Estimate - Hudson, WY
45 MIL RPP liner	sf	$0.61	215,250	$131,302.50	Engineer's Estimate - Hudson, WY
6 OZ Geocomposite drainage layer	sf	$0.40	215,520	$86,208.00	CostWorks 2006
Tilling contaminated soils in LTU (8 times per phase)	sy	$0.59	760,000	$448,400.00	Engineer's Estimate
Treated soil backfill (assumed to be same $ as clean soil backfill)	cy	$10.84	178,432	$1,934,202.88	RACER
Berm removal after treatment is completed	cy	$1.69	9100	$15,379.00	CostWorks 2006
Demolition of piping	lf	$7.50	600	$4,500.00	CostWorks 2006
Demolition of manhole	ea	$172.00	2	$344.00	CostWorks 2006
Haul road demolition	cy	$1.44	8300	$11,952.00	CostWorks 2006
			Subtotal	**$4,069,545.80**	
Construction Contingencies		25%		$1,017,386.45	10% Scope, 15% bid
			Subtotal	**$5,086,932.25**	
Project Management		6%		$305,215.94	EPA Cost Guidance
Remedial Design including Pilot Testing		12% plus $100,000		$710,431.87	EPA Cost Guidance
Construction Management		8%		$406,954.58	EPA Cost Guidance
			Subtotal	**$1,422,602.39**	
		TOTAL CAPITAL COSTS		**$6,509,534.64**	

ANNUAL OPERATIONS AND MAINTENANCE COSTS

Item	Unit	Unit Cost	Quantity	Cost	Source
Site Operation and Maintenance (technician)	wk	$450.00	50	$22,500.00	
Water	ls	$2.00	25,000	$50,000.00	
Miscellaneous (repairs, fertilizer, materials, etc.)	ls	$10,000.00	1	$10,000.00	
			Subtotal	**$82,500.00**	
O&M Contingencies		25%		**$20,625.00**	10% Scope, 15% Bid
		TOTAL YEARLY O&M COSTS		**$103,125.00**	

Present Value	**3%**
50 years	$ 9,162,920.00

Present value includes capital costs and O&M costs for 50 years

Table 4
Preferred Remedy Cost Estimate
Sludge Removal
KRY Site

CAPITAL COSTS

Item	Unit	Unit Costs	Quantity	Cost	Source
Mobilize equipment	EA	$10,000.00	1	$10,000	See Assumptions
Excavate and load, bank measure, medium material	BCY	$1.18	3,126	$3,689	RACER
Recycling at Asphalt Batch Plant (including transportation)	TON	$70.00	6,583	$460,810	Vendor quote
			Subtotal	**$474,499**	
Construction Contingencies		25%		$118,625	
			Subtotal	**$593,123**	
Project Management		6%		$35,587	EPA Cost Guidance
Remedial Design		12%		$71,175	EPA Cost Guidance
Construction Management		8%		$47,450	EPA Cost Guidance
			Subtotal	**$154,212**	
		TOTAL CAPITAL COSTS		**$747,335**	

Assumptions:
- Mobilization cost is a blind estimate. Specific contractors and their locations were not determined for this estimate.
- Assumes that 3126 cubic yards of in-place soil need to be excavated.
- Assumes that recycling costs include transportation (per vendor quote)
- Assumes that one cubic yard of soil weighs 1.62 tons and a fluff factor of 1.3 for medium soils
- Assumes no backfill due to minimal amount of soil and LTU sited in this location

Notes:
Cost estimate based on 2007 economics; Assume 2-3% increase per year for inflation
EA = Each
BCY = Bank cubic yard

Present Value	3%
1 year	$747,335.00

Table 5
Preferred Remedy Cost Estimate
Lead Soils Removal
KRY Site

CAPITAL COSTS

Item	Quantity	Unit	Unit Cost	Cost	Source
SOIL EXCAVATION					
Mobilize equipment	1	EA	$10,000	$10,000	See Assumptions
Excavate and load, bank measure, medium material	2,196	BCY	$1.18	$2,591	RACER
Unclassified fill, 6" lifts, offsite, spreading and compaction	2,855	CY	$10	$28,006	RACER
Lab testing, metals	10	EA	$150	$1,500	RACER
Spray washing truck station	1	EA	$318	$318	RACER
EX SITU SOLIDIFICATION/STABILIZATION					
Mobilize equipment	1	EA	$20,000	$20,000	
910 Wheel Loader	25	HR	$67	$1,672	RACER
12 CY dump truck	25	HR	$76	$1,909	RACER
Aboveground water holding tanks	1	MO	$336	$336	RACER
Chemical fixation & stabilization agents (CKD)	1,782	TON	$27	$48,524	RACER
Chemical fixation & stabilization agents (other agents)	268	TON	$92	$24,608	RACER
Urrichem proprietary additive	18	TON	$1,299	$23,382	RACER
Operational labor	49	HR	$33	$1,608	RACER
15CY waste mixer	1	MO	$6,185	$6,185	RACER
Stabilization ancillary equipment	1	EA	$9,411	$9,411	RACER
TRANSPORTATION (KALISPELL, MT)					
Bulk solid haz waste loading into truck	2,855	CY	$2.26	$6,452	RACER
Waste disposal fees	3,074	TON	$45	$138,348	RACER
Waste Hauling*	126	EA	$160	$20,160	includes fuel, liners, and trips
Truck washout **	126	EA	$177	$22,254	RACER
			Subtotal	**$367,262**	
Construction Contingencies		25%		$91,815	10% Scope, 15% Bid
			Subtotal	**$459,077**	
Project Management		6%		$27,545	EPA Cost Guidance
Remedial Design including treatability testing		12% + $5,000		$60,089	EPA Cost Guidance
Construction Management		8%		$36,726	EPA Cost Guidance
			Subtotal	**$124,360**	
		TOTAL CAPITAL COSTS		**$583,438**	

Assumptions:
- Mobilization cost is a blind estimate. Specific contractors and their locations were not determined for this estimate.
- Assumes that 2,196 cubic yards of in-place soil need to be excavated. For this cost estimate, a volume of 2,855 cubic yards of soil (which includes a fluff-factor) is assigned for loading and transportation. These soils will be transported locally and 50% will require stabilization.
- Assumes that cement kiln dust will be used as the stabilizing agent.
- Assumes that 50% of the total estimated soil volume will require stabilization prior to disposal
- Local landfill in Kalispell, MT will generate the profile and grant acceptance of subject soil

* Waste disposal trucks will make an estimated 126 round trips from KRY site to local landfill; Due to the proximity of the landfill (assumed to be 10 miles from the site) RACER estimates a unit cost per truck

RT = Round Trip
MO = Month
MI = Mile
LS = Lump sum

Present Value	3%
1 year	$583,438

Table 6
Preferred Remedy Cost Estimate
Free-Product Removal by Excavation
KRY Site

CAPITAL COSTS

Item	Unit	Unit Costs	Quantity	Cost	Source
Mobilization	ls	$100,975.26	1	$100,975.26	Engineer Estimate
Contaminated soil excavation and hauling	cy	$5.63	148,148	$834,073.24	CostWorks 2006
Dewatering/extraction	LS	$40,000.00	1	$40,000.00	Engineer Estimate
LNAPL Disposal (Reliance)	GAL	$1.00	99,500	$99,500.00	Vendor Quote
Residual Waste Management	LS	$7,804.00	1	$7,804.00	
Treated Soil backfill	cy	$10.84	148,148	$1,605,924.32	
			Subtotal	**$2,688,276.82**	
Construction Contingencies		25%		$672,069.21	10% Scope, 15% bid
			Subtotal	**$3,360,346.03**	
Project Management		6%		$201,620.76	TTEMI - EPA Cost Guidance
Remedial Design		12%		$503,241.52	TTEMI - EPA Cost Guidance
Construction Management		8%		$268,827.68	TTEMI - EPA Cost Guidance
			Subtotal	**$973,689.97**	
		TOTAL CAPITAL COSTS		**$4,334,035.99**	

Assumptions:
- Assumes that the free-product plume covers a 400 ft by 400 ft area at Reliance and is 20 feet below ground surface .
- Assumes the smear zone is 5 feet thick.
- Assumes that sloping will be used to prevent cave-in of the excavation, rather than shoring
- Assumes that residual waste management will cover booms, etc., to remove free-product once the excavation is complete.

Present Value	**3%**
1 year	$4,334,035.99

Table 7
Preferred Remedy Cost Estimate
Chemical Oxidation
Groundwater
KRY Site

CAPITAL COSTS

Item	Unit	Unit Costs	Quantity	Cost	Source
Geologist	hr	$75.00	200	$15,000.00	RACER
DOT Steel Drums, 55-gallon	ea	$83.22	1312	$109,184.64	RACER
4-inch PVC, SCH80 well casing	lf	$19.19	5425	$104,105.75	RACER
4-inch PVC, SCH80 well screen	lf	$21.12	1990	$42,028.80	RACER
Rotary Drilling, 8-inch borehole (< = 100 ft)	lf	$51.00	5425	$276,675.00	RACER
4-inch bentonite seal	ea	$20.16	193	$3,890.88	RACER
1-inch stainless steel piping	lf	$19.16	5425	$103,943.00	RACER
Trenching	cy	$8.55	2666	$22,794.30	RACER
Ozone System (1)	ls	$74,685.00	15	$1,120,275.00	Vendor Quote
SCADA System and radio telemetry	ls	$14,285.72	15	$214,285.80	Vendor Quote
			Subtotal	**$2,012,183.17**	
Construction Contingencies		25%		$503,045.79	10% Scope, 15% bid
			Subtotal	**$2,515,228.96**	
Project Management		6%		$150,913.74	EPA Cost Guidance
Remedial Design including Pilot Testing		12% plus $100,000		$401,827.48	EPA Cost Guidance
Construction Management		8%		$201,218.32	EPA Cost Guidance
			Subtotal	**$753,959.53**	
		TOTAL CAPITAL COSTS		**$3,269,188.49**	

ANNUAL OPERATIONS AND MAINTENANCE COSTS

Item	Unit	Unit Cost	Quantity	Cost	Source
Site Operation and Maintenance	wk	$2,000.00	50	$100,000.00	
Power	kwh	$0.08	858480	$68,678.40	
Water	gal	$2.25	500	$1,125.00	
			Subtotal	**$169,803.40**	
O&M Contingencies		25%		**$42,450.85**	10% Scope, 15% Bid
		TOTAL YEARLY O&M COSTS		**$212,254.25**	

Present Value	**3%**
10 years	$5,079,759.00

Present value includes capital costs and O&M costs for 10 years

Table 8
Preferred Remedy
Common Elements
KRY Site

CAPITAL COSTS

Item	Unit	Unit Costs	Quantity	Cost	Source
Administrative Costs					
Controlled Groundwater Area	LS	20,000	1	20000	DEQ estimate
Zoning/Restrictive Covenents	LS	2500	1	2500	DEQ estimate
			Subtotal	**$22,500**	
Contingencies		25%		$5,625	
		TOTAL CAPITAL COSTS		**$28,125**	
OPERATIONS AND MAINTENANCE COSTS					
Long-Term Monitoring (one event)					
Equipment rental	LS	$1,500.00	1	$1,500	
Deep well sampling labor	HR	$80.00	45	$3,600	DEQ estimate
Shallow well sampling labor	HR	$80.00	42	$3,360	DEQ estimate
Sample Analysis	well	$1,773.00	57	$101,061	Laboratory Price Schedule
			Subtotal	**$109,521.00**	
Contingencies		25%		$27,380.25	
		TOTAL O&M COSTS (PER YEAR)		**$136,901.25**	

Assumptions:

- Long-term monitoring assumed to include 57 monitoring wells (15 deep and 42 shallow); sampling using a bladder pump
- Assumes that sampling will take 3 hours per deep well and 1 hour per shallow well
- Analytical suite includes MNA parameters (dissolved oxygen, temperature, pH, oxidation/reduction potential, nitrate, sulfate, ferrous iron, and dissolved manganese), PCP (low-level), SVOCs, PAhs (low level, in combination with SVOCs), dioxin/furans, petroleum hydrocarbons (EPH/VPH), and metals. Cost reported as a lump sum per well, whcih includes costs for all these analyses.
- Semi-annual sampling first five years, then annually for 25 years

Net Present Value	3%
30 years	$3,338,416